Notes on the biology of some grasshoppers from the Rukwa Valley, S. W. Tanganyika

(Orth. Acrididae)

BY

I. A. D. ROBERTSON and R. F. CHAPMAN (*).

Tanganyika & London.

INTRODUCTION.

During work on the reproduction of the Red Locust *(Nomadacris septemfasciata* (Serville) in the Rukwa Valley, Tanganyika Territory, notes were made on the biology of the other species of Acrididae present. Much information was obtained about the life histories and reproduction of the grasshopper species and this information throws into relief the peculiarities of the Red Locust and puts that species into perspective amongst its relatives in the same and neighbouring habitats.

The Rukwa Valley is one of the three permanent outbreak regions of the Red Locust in Africa south of the equator and contains several separate outbreak areas. The present work was done during 1956 in Central Rukwa, near Kafukola Research Station.

The valley lies between latitudes 7° and 9° South and longitudes 31° and 33° East (Fig. 1). It is approximately 200 miles long and 40 miles wide and is a closed valley, having no drainage outlet, lying between two parallel escarpments which vary in height from 300 to 3000 feet above the valley floor and with rising ground at both ends. The valley is orientated NW-SE and the flat valley floor is 2600 feet above sea level. Lake Rukwa lies in the southern half of the valley and is approximately 80 miles long, varying in width from 5 to 30 miles. It is a shallow alkaline lake, the water level varying according to the rainfall in the drainage area; in some years the northern half of the lake may be completely dry. Fringing the foot of the escarpment is a belt

(*) Ukiriguru Research Station, P. O. Fela, Lake Province, Tanganyika and Zoology Department, Birkbeck College, London.

of 'Miombo' woodland which varies in depth from 4 to 20 miles and between the forest and the lake lie the grass plains which support the Red

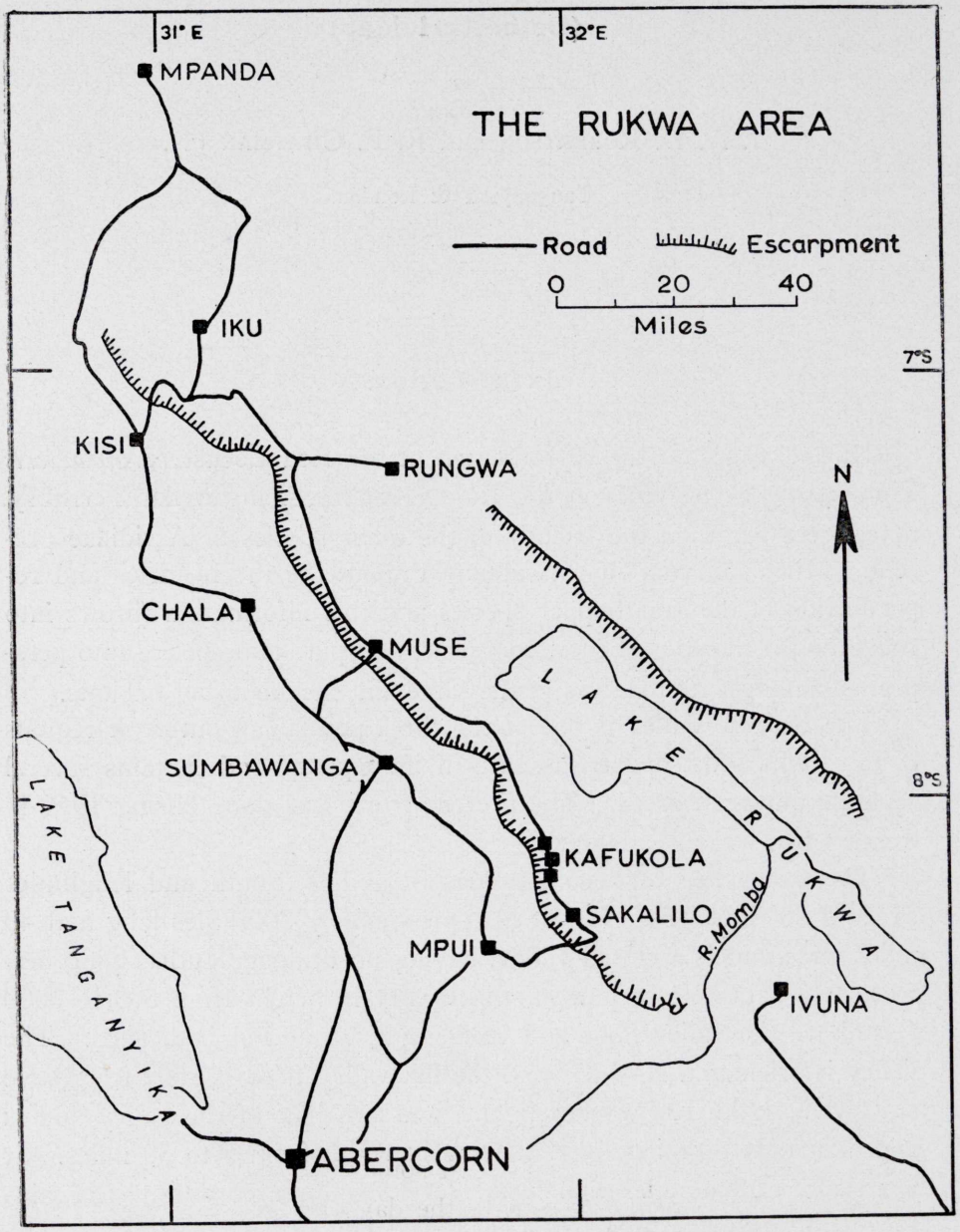


Fig. 1. Map of the Rukwa Rift Valley.

Locust population. The grasslands total some 1000 square miles and Central Rukwa alone, where the grasshopper work was done, is about 550 square miles in extent.

In general the soil of the Rukwa Valley appears to be similar to 'black cotton soil', but being in an enclosed valley there is an accumulation of alkaline deposits. There is a black surface layer which varies in depth from six inches to several feet, and a very deep lower layer of almost white silty clay. This soil becomes very hard and cracks badly in the dry season, and becomes very wet, heavy and plastic in the rainy season. Little soil analysis has been done recently, although a good deal of work was done by Milne (1937). The recent data show that the pH varies from 7.4 to 10.7 and the conductivity varies from 500 to 2400 milliohms^{-1}. In most places in the grassland it has been found that water brought up from wells is saline to some degree.

Climate.

The rainfall in the valley is very erratic and from 1952 to 1956 varied from 25 to 40 inches per season at one station. The rainy season lasts from November to April, the rest of the year being completely dry. Due to the type of soil and to the fact that there is no drainage out of the valley the grass plains tend to flood extensively during the wet season, sometimes to a depth of several inches or even a foot or two and sometimes for up to three or four months in a year; there is historical evidence of flooding lasting several years (Gunn, 1956). In general, extensive flooding occurs from January to April, during the period when grasshopper nymphs are most abundant.

The dry season is very severe. Some species of grass (e. g. *Hyparrhenia)* mature and dry up in April before the end of the rains, even when there is standing water. Others (e. g. *Echinochloa)* retain some green leaf as long as there is soil moisture, but broadly speaking by August most of the surface water has disappeared; by October conditions become very arid, the maximum shade temperature reaching 40° C. and relative humidity falling to 20 % at midday. The soil forms a very hard crust and cracks deeply, some of the cracks extending down for several feet. There is evidence that some species of Acrididae shelter in these cracks during the heat of the day (Joyce, 1952; Lean, 1936), only being active in the morning and late afternoon.

To add to the drought, when the heavy grass cover becomes really dry, normally about August, fierce grass fires, usually lit by the local

Africans, sweep across the plains. Late in the dry season these fires may leave completely black bare ground behind them, although earlier fires usually leave some patches of unburnt grass and many grass stems still standing. Even in the height of the dry season, however, the grass regenerates to some extent and it is not long before the burnt areas are permanently colonised by grasshoppers. It has been observed that locusts and grasshoppers will fly back into a burnt area immediately after a fire has passed, while the ground is still warm, but whether they establish themselves there before the grass begins to regenerate is not certain. It is fairly certain that most species of *Acrididae* are capable of escaping from the fiercest of grass fires and it is considered that relatively few are destroyed.

In Table I are shown the rainfall and temperature data from three stations: Kapombo is on the side of the escarpment, Kafukola is on the floor of the valley at the edge of the woodland and MIO, a landmark beacon, is four and a half miles out in the grassland (Fig. 2). Although there are only six miles between the stations it will be seen that there are considerable differences in conditions. The three stations typify conditions in the three types of habitat shown in Table 2. The rainfall is greatest on the escarpment and least on the grassland, while the maximum temperature is greatest on the valley floor and least on the escarpment; the minimum temperature is nearly the same in all three. The lowest minimum temperatures are recorded in June and July, in the dry season. The maximum temperature is recorded at the end of the dry season, but begins to drop as soon as the wet season commences; the minimum temperature remains fairly steady during this period. The relative humidity is fairly low in the dry season and rises sharply at the beginning of the rains.

Grasshopper habitats.

Collections of grasshoppers were made in several different habitats within the grassland, in the woodland adjacent to the plains, and in the woodland on the side of the escarpment some 600 feet above the floor of the valley.

1. *The grassland habitats.*

On the grass plains of the Rukwa Valley there are only a few important species of grass and these tend to grow in huge areas of practically pure stand; there are nevertheless areas where these important grasses become quite intimately mixed. In a few areas there are co-dominant species. It was decided that the collection of grasshoppers should be limited to areas in which grasses were growing in as near pure stand as possible, so that any difference in fauna might be given maximum emphasis. It must be realised that the dominant grasses which give the character to the area are usually tall and coarse and that they often have short grasses growing beneath them which may be preferred as food by the grasshoppers, so that the effect of the dominant grasses on the composition of the grasshopper fauna may only be an indirect one. Collections were made in four habitats, dominated by *Sporobolus robustus, Echinochloa pyramidalis, Diplachne fusca* and *Hyparrhenia rufa* respectively.

Sporobolus robustus is a tall, coarse and extremely tough grass growing to a height of six to eight feet. It characterises the shore zone of many alkaline lakes in Africa and it perisists for many years after the lake has receded; the collecting area was about six miles from the nearest open water in 1956. Underlying the *Sporobolus* may be found shorter grasses and sedges such as *Sporobolus spicatus, Cynodon dactylon* and *Cyperus longus*. Some of the tall grass *Hyparrhenia rufa* was also present in the collecting area.

Echinochloa pyramidalis is a tall, coarse grass growing ten or twelve feet in height. It grows in areas subject to fresh water flooding, characterising the wetter areas away from the lake and often being found fringing river channels. Again *Cynodon dactylon* and *Cyperus longus* are the most important of the short grasses and sedges found growing beneath it. In this habitat a few herbs are also found, the more common being *Ipomoea aquatica, Sesbania tetraptera, Hibiscus panduriformis,* and *Aeschynomene indica.*

Diplachne fusca is a shorter grass, growing to a height of about four feet and, in the area of collection, growing in a very pure stand. It is indicative of alkaline conditions and is a lake shore grass which can survive in shallow brackish water. It can also however survive

for many years under dry land conditions when the lake has receded. The area of work was about six miles from the nearest open water and was only very gradually being colonised by other species.

Hyparrhenia rufa is a tall grass growing up to ten feet in height found in the drier areas, often fairly near the edge of the woodland. *Hyparrhenia,* although the dominant grass in the area of work, does not mature until late in the season and so for the first two or three months of the wet season it is not very obvious. Its dominance at this time is masked by the tall early annual grass, *Rottboellia exaltata,* which also grows to about ten feet, and the perennial *Chloris gayana* which grows to about four feet. The area of collection, adjacent to the forest edge, had been fire protected for two years and a number of herbs were evident for the first two or three months of the rainy season. The more common were *Lissochilus* sp., *Ipomoea aquatica, Gladiolus quartiniarius, Aeschynomene indica* and *Sesbania tetraptera.*

2. *The woodland habitats.*

The two woodland habitats sampled were very similar in vegetation. One area was in the woodland adjacent to the plains and it was hoped that this would show whether many species were common to both woodland and grassland; the boundary between woodland and grassland was sharp and well defined and probably indicated a sudden change of soil conditions. The other area was about three miles within the woodland on the lower slopes of the escarpment where it was expected there would be little interchange between the grassland and woodland species. Although it had a higher rainfall, the area on the side of the escarpment was better drained and drier than the flat woodland adjacent to the grassland. The commoner species of trees in the woodland were — *Acacia holycantha, Acacia xanthophloea, Acacia tortilis, Ficus sycamorus, Lonchocarpus capassa, Tamarindus indica, Sterculia quinqueloba, Adansonia digitata, Kigelia aethiopica, Piliostigma thonningii Pterocarpus angolensis, Brachystegia* sp., and *Combretum* sp. The dominant grasses were *Panicum maximum, Digitaria milanjiana* and *Hyparrhenia dissoluta.* Other common grasses and herbs were *Dactyloctenium aegyptum, Sporobolus festivus, Setaria orthosticha, Eleusine indica, Macuna pruriens, Indigofera demissa, Borreria ruelliae, Chloris gayana, Pennisetum purpureum, Solanum campylacanthum* and

Tribulus cistoides. There were many native villages in the woodland growing a considerable variety of crops, such as millet, maize, sorghum, cassava, sweet potatoes, beans, groundnuts and bananas.

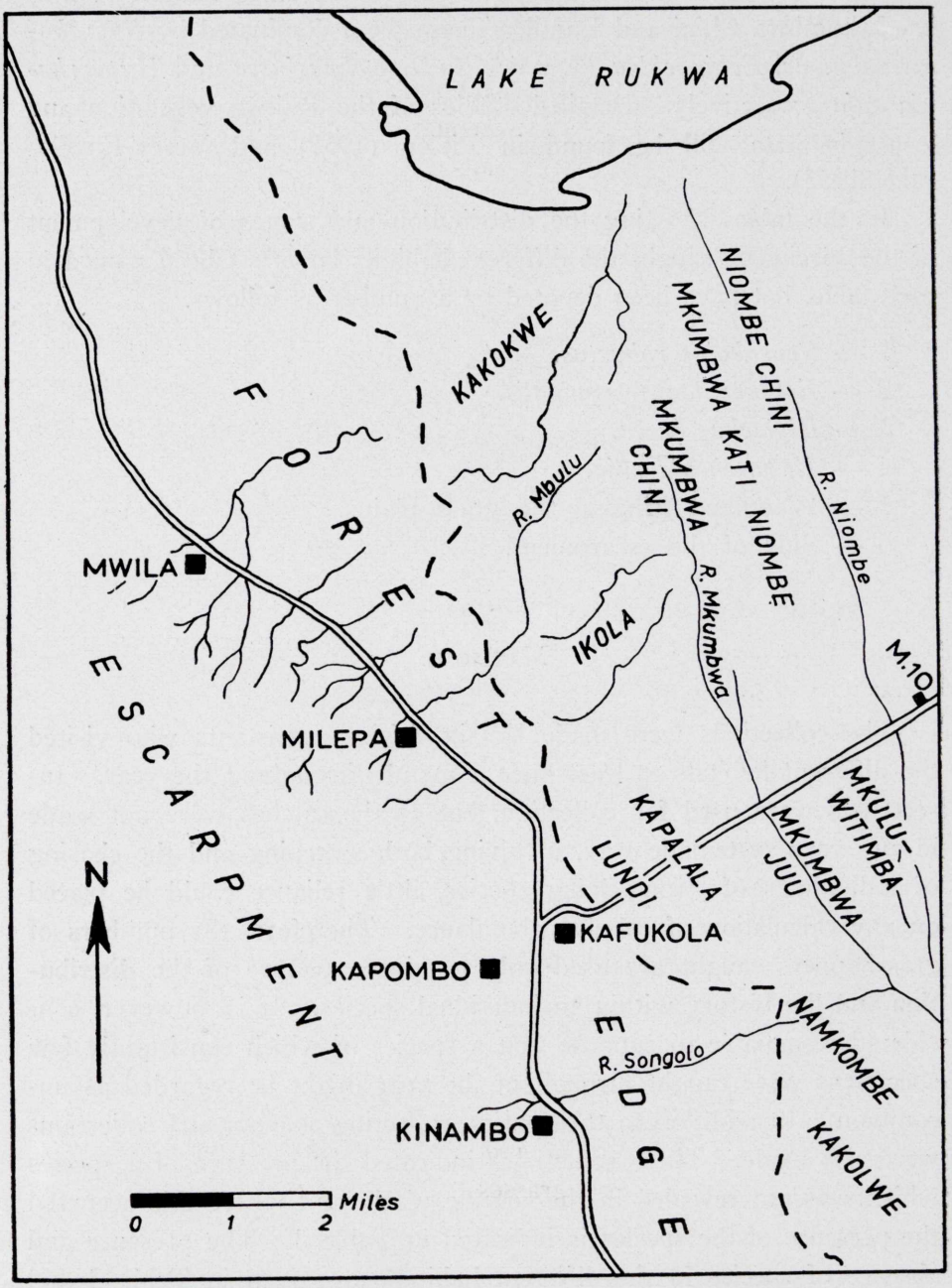


Fig. 2.—Map of the Central Rukwa Area giving the names of the plains in which collecting was carried out.

The positions of the habitats can be seen in Fig. 2. Kapombo is the woodland habitat on the side of the escarpment; Kafukola the woodland habitat on the edge of the grassland. Within the grassland collecting was carried out in the plains called Kapalala, Mkulu Witimba, Mkumbwa Chini and Lundi. These were dominated by *Sporobolus robustus, Echinochloa pyramidalis, Diplachne fusca* and *Hyparrhenia rufa* respectively. Detailed studies of the Rukwa vegetation and locust habitats will be found in Pielou (1952) and Vesey-FitzGerald (1955).

In the tables showing the distribution and stages of development of the specimens caught the different habitats have not been named in each table, but have been denoted by a number as follows.

1 — *Sporobolus robustus.*
2 — *Echinochloa pyramidalis.*
3 — *Diplachne fusca.*
4 — *Hyparrhenia rufa.*
5 — Woodland fringing the grass plains.
6 — Side of the escarpment.

Methods.

The collections were made by six African assistants who visited the different habitats at least once a month throughout the year. Insect nets were used for collection, but as the catches were not made in any very systematic way, involving both sweeping and the chasing of individuals of strong-flying species, little reliance could be placed on any calculation of relative abundance. Therefore, the numbers of grasshoppers caught are used only to give a picture of the distribution and life history within an individual species. It is, however, considered reasonable to suppose that a species of which consistantly few specimens were caught throughout the year might be regarded as uncommon. In addition to the routine collecting some casual collections were also made. These sometimes indicated the presence of a species which was not revealed in the routine work, and where this occurred the presence of the species is indicated in Table 3. The presence and absence of species in the different habitats are given in Table 2 and the seasonal distribution of the different stages in Table 3.

Many of the grasshoppers caught in the field were kept in cages, in which many of the egg pods obtained were laid. There was little question of the time of egg-laying being much affected by the cage environment as the cages were replenished from each catch made and most of the eggpods came from mature females whose ovaries had already begun to develop in the field. Descriptions of the egg pods with data on the sizes of the eggs and the number of eggs per pod of the species starred in Table 2 are given in Chapman and Robertson (1958).

When possible, dissections were made of females on the day when they were caught in the field. The length of the ovary and the length of the eggs (E_1) in the ovarioles were measured and the number of ovarioles were counted.

The grasshopper fauna.

In the grasslands of the Rukwa Valley there is a relatively restricted grasshopper fauna, but, as with the grasses, the more important species are present in great numbers. In the woodland habitats there is considerably more variety and while we consider it correct to say that very few of the grassland species were missed, it is very probable that many of the woodland species were not caught.

Throughout the paper the classification follows that of Johnston (1956).

ACRIDIDAE

Subfamily — PAMPHAGINAE.

Lamarckiana kilosana Miller.

Only one female was caught in January in *Hyparrhenia.*

Subfamily — PYRGOMORPHINAE.

Chrotogonus hemipterus Schaum.

This species was almost entirely restricted to the woodland. 2 % were found in the *Sporobolus,* 7 % in the fringing woodland and 91 %

on the side of the escarpment. The species is non-graminivorous, which is probably the factor limiting its spread to the grassland where herbs are uncommon. In the fringing woodland most of the specimens were taken in association with bare ground amongst native cultivation.

Adults were found from April to December and hoppers from June to November; egg pods were obtained from October to November and in February. The ovaries of 17 females were examined and development was found from April to November. Joyce (1952) states that in the Sudan under favourable conditions breeding is continuous. In the Rukwa insufficient data were available, but the breeding season was clearly extensive. Maximum ovary length 9.5 mm. with eggs in ovarioles and, in November, in oviducts 4.5 mm. long. Ovariole number 15 + 14 to 17 + 19 (6), average 33. (Figures in parenthesis indicate the number of specimens examined.)

Phymateus viridipes Stål.

A single specimen was taken in December within the fringing woodland. The species is fairly common on the Ufipa Plateau in *Brachystegia* woodland at an altitude of about 6000 feet.

Zonocerus elegans (Thunb.).

This species is non-graminiverous and all the specimens came from the woodland habitats. Although it is a major pest of crops elsewhere in Africa the numbers present in the Rukwa were relatively small.

Adults were obtained from December to March and hoppers from November to January. It is unlikely that this conspicuous species was overlooked in those months when it was not taken and this suggests that it has a single generation per year with an egg diapause during the dry season. This is supported by the fact that in a single female examined in March the eggs were almost ready to lay. The ovary was 21.5 mm. long, the length of the eggs in the ovarioles being 4.8 mm. and the number of ovarioles 74 + 69.

Pyrgomorpha dispar Miller.

Only 3.5 % of the specimens were caught in the grassland (Table 4), 71.5 % were taken in the fringing woodland and the remaining 25 % on the side of the escarpment. The species is non-graminivorous which is probably the limiting factor in its ditribution. Two distinct colour forms were caught, green and olive brown.

Adults were obtained in every month except March, July and August, and hoppers in every month except January, April and December. Egg pods were obtained from October to December and development of the ovaries was also noted in June, November and December, the only months in which dissections were made. It therefore appears that the species breeds throughout the year, although (Table 4) there is some indication that there may be two generations per year, an increase in young hoppers being seen in August — September and in February, at which times there is also a decrease in the numbers of adults caught.

Maximum ovary length 20.0 mm. with eggs in ovarioles 4.8 mm. long. In June one specimen, in November three specimens and in December two had eggs in the oviducts and in all these the egg-length was 4.5 mm. or above. Ovariole number 47 + 44 to 72 + 71 (21), average 120.

Subfamily — CATANTOPINAE.

Leptacris monteiroi (I. Bol.).

Only three adults were caught in August and September in *Hyparrhenia*. Their colouration, reddish brown with a lateral silver stripe, blends especially well with the colour of dry *Hyparrhenia* and in any other grass they would be much more conspicuous. The species is sluggish and its habit is to rest pressed closely to the grass, which makes it very difficult to see, so that perhaps it is more common than our catches seem to indicate.

Acanthoxia gladiator (Westw.).

A plains dwelling species very common in the second half of the year. Only one specimen was caught within the woodland. In the grassland 45 % were taken in *Sporobolus*, 29 % in *Echinochloa* and the remaining 25 % were fairly evenly divided between *Diplachne* and *Hyparrhenia*.

Adults were taken from August to January, hoppers from March to May and egg pods were obtained from October to December. A total of 94 ovaries were examined during the months August to November (Table 5) and these indicate that development started in September, but was not general until November. The species has a single generation per year, the adults surviving the dry season. Maximum ovary length 27.0 mm. with eggs in ovarioles 6.0 mm. long. Eggs in oviducts 5.0-6.0 mm. long. Ovariole number 29 + 29 to 35 + 35 (15), average 63.

Acanthoxia is a poor jumper and its normal habit is to cling closely to a grass stem and, when the grass is dry, by its straw yellow colour, shape and behaviour, it looks very much like a piece of grass and is very difficult to see. When disturbed it tends to move round the grass stem, keeping on the far side from the observer, and is often difficult to flush.

Twelve hoppers from third to sixth instar were caught, in *Diplachne* and *Echinochloa*. The rostrum develops gradually throughout the instars, the third instar hoppers having only a very short extension of the vertex, while the sixth instar hoppers had an extension nearly twice as long as the rest of the head.

Adults were only caught from August to January. When they were found they were present in large numbers and it was noted that none was caught until after the large grass fires which swept through Central Rukwa in August. It is possible that, due to their behaviour, the African collectors missed them completely until the fires had concentrated them in the remaining unburnt grass. From the drop in numbers caught in November (Table 6) it may perhaps be taken that the majority of the adults die in that month, only a small proportion remaining alive until January. However, the Red Locust is known to disperse at the beginning of the rains and this could also be the case with *Acanthoxia*.

Afroxyrrhepes acuticercus (Dirsh).

Several adults were caught within the woodland in November and December and egg pods were obtained in the same months. One female examined in December had an ovary 14.0 mm. long, the length of the eggs in the ovarioles being 3.5 mm. and the number of ovarioles 40 + 37.

Afroxyrrhepes procera (Burm.) and **Anoxyrrhepes prosternalis** (Karny).

These two species were not differentiated in the field so that little can be said about distribution, although specimens were caught in both the grassland and the woodland, the percentages being 12 % in the woodland and 88 % in the grassland. It was noted that after June the numbers caught fell off sharply.

Hoppers were found from January to March and adults from March to December.

The data which were obtained from the specimens positively identified are given below.

Afroxyrrhepes procera (Burm.).

No adults of this species were caught after June and the ovaries of ten females examined during May and June reached 29.5 mm. in length, with eggs up to 6.0 mm., at which length one specimen in June had eggs in the oviducts. Egg pods were obtained in May and June, the adults then die off and the eggs survive the dry season in diapause. Ovariole number 43 + 42 to 51 + 49 (9), average 92.

Anoxyrrhepes prosternalis (Karny).

No postively identified specimens of this species were taken before September, but the ovaries of eight specimens examined from Sep-

tember to December had all started to develop. One in December had eggs in the ovarioles 5.0 mm. long and the number of ovarioles was 29 + 27, which is very different from the number found in *Afroxyrrhepes*. *Anoxyrrhepes* may survive the dry season as adults, eggs being laid at the beginning of the wet season.

Anoxyrrhepes sp.

A single specimen was caught within the fringing woodland in November.

Homoxyrrhepes punctipennis (Walk.).

A single adult was caught in June in the grassland, in *Echinochloa*.

Tristria dimorpha I. Bol.

Three adults were caught within the grassland in August.

Tristria pallida Karny.

Adults were found from September to January, all within the grassland.

T. dimorpha and *T. pallida* were not separated in the field so no differentiation can be made concerning the distribution in the grassland habitats. They were widely distributed, 30 % being taken in *Sporobolus*, 40 % in *Echinochloa*, 13 % in *Diplachne* and 17 % in *Hyparrhenia*, but were relatively uncommon, only 30 specimens being taken. No hoppers were found but egg pods were obtained from November to January.

Poecilocerastis striata striata Ramme.

This species was confined to the woodland and was uncommon, having a very restricted distribution, probably connected with a non-graminivorous diet. It was commoner on the Ufipa Plateau, above

the western escarpment, at an altitude of about 6000 feet in *Brachystegia* woodland.

Adults were taken from October to January and egg pods were obtained in November and December. It therefore seems likely that there is a single generation per year, the adults surviving the dry season.

Epistaurus sp.

94 % of the specimens obtained came from the fringing woodland and 6 % from the grassland in the *Diplachne, Hyparrhenia* and *Echinochloa.* None was taken on the escarpment.

Adults were taken in January and from June to December. Egg pods were obtained in November.

Ovaries showed development of the eggs in August, October and November.

Bocagella bolivari Miller.

A single nymph was caught in March in *Sporobolus.* This species was found on several occasions on the Ufipa Plateau at an altitude of 6000 feet.

Abisares viridipennis (Burm.).

Only three specimens were taken, all from the fringing woodland, during November and December.

Catantops axillaris axillaris (Thunb.).

A common species found in all habitats. A total of 1284 specimens was caught (Table 7), 87 % from the grassland, 11 % from the fringing woodland and 2 % from the side of the escarpment. Within the grassland 49 % were caught in *Sporobolus,* 34.5 % in *Echinochloa,* 12 % in *Diplachne* and 4.5 % in *Hyparrhenia.*

Adults were taken in all months except February; hoppers were

found from January to June. Ovaries were examined and development found from August to December, but egg pods were only obtained from November to January. The species thus has a single generation per year with the adults surviving the dry season. In December the length of the ovaries reached 17.5 mm. with eggs in the ovarioles and oviducts 5.0 mm. long.

Catantops decipiens Karsch.

A few adults of this species were caught in the woodland habitats from November to January. No hoppers were caught, but egg pods were obtained in December.

Catantops melanostictus Schaum.

This species was taken in all the habitats, but there was found to be a considerable change in distribution throughout the year. From February to October 339 specimens were caught, and of these 8.5 % came from the grassland, 40.5 % from the fringing woodland and 51 % from the side of the escarpment (Table 8). In the months November to January, however, 733 specimens were caught and of these 77 % came from the grassland, 12.5 % from the fringing woodland and 10.5 % from the side of the escarpment. It may be that although the grasshoppers were mainly restricted to the woodland during the dry season, when the rains began, or even before, that is at the beginning of the breeding season, a large scale movement took place, leaving relatively few within the woodland. From February to October there was a slightly uneven scatter of individuals in the grassland, but the numbers were so low that little reliance can be placed on the differences. In the months November to January however, it was found that of the 565 specimens caught in the grassland 37 % were in the *Hyparrhenia,* which was adjacent to to the forest edge, 33.5 % were in the *Echinochloa,* 21.5 % in *Sporobolus* and 8.0 % in *Diplachne.*

Adults were caught in every month except February. Hoppers were taken from February to May and egg pods were obtained in November and December. No development was seen in the ovaries exa-

mined from August to October, but in November and December they were developing. The species thus has a single generation per year and the adults survive the dry season. Golding (1948) suggests that in Nigeria there are two generations per year. Maximum ovary length 14.0 mm. with eggs in ovarioles 5.0 mm. long. Eggs in oviducts 4.0-5.0 mm. long. Ovariole number 24 + 22 to 29 + 31 (12), average 54.

Catantops spissus adustus (Walk.).

The species was mainly confined to the side of the escarpment, 60 % of the total numbers being taken there; 18 % were taken in the fringing woodland and 22 % in the grassland. There is a slight suggestion that the fairly high percentage taken in the grassland in November might be the result of a spreading out from the woodland at the start of the rainy season, but too few specimens were taken to allow a conclusion to be drawn.

Adults were taken in May and from November to January, and egg pods were obtained in November and December. It seems likely that there is a single generation per year. Golding (1958) states that there are at least two generations per year at Ibadan in Nigeria.

Only one ovary was examined, in December, and its length was 10.0 mm., the length of the eggs in the ovarioles being 3.0 mm. and the number of ovarioles 29 + 28.

Phaeocatantops decoratus decoratus (Gerst).

61 % were taken on the side of the escarpment, 26 % in the fringing woodland and 13 % in the grassland where a few specimens were taken in all the habitats except *Diplachne*.

Adults were found from July to January and egg pods were obtained in November. The adults therefore survive the dry season.

Developing ovaries were found in November and December and they reached a length of 12.5 mm. with eggs in ovarioles and oviducts 4.5 mm. long. Ovariole number 20 + 18 to 23 + 24 (10), average 43.

Anthermus viridipes (Karny).

This distinctive species was uncommon, except in some very limited areas within the fringing woodland. In cages herbs were preferred to grass and it is considered likely that its range within the woodland is restricted by this.

Adults were found from September to December and egg pods in December. It seems likely that the species has a single generation per year.

Rhytidacris tectifera (Karsch).

A single adult was caught in the fringing woodland in November.

Orthacanthacris humilicrus (Karsch).

This species was confined to the woodland, the adults being associated with *Acacia* trees; the hoppers were, however, found on the ground.

Adults were caught in March, July, August and from November to January, hoppers in January and egg pods were obtained in December and January. This suggests that the species has one generation per year, the adults surviving the dry season.

Nomadacris septemfasciata (Serville).

A considerable amount of work has been done on the Red Locust and it is only intended here to give the data which were obtanied in the course of the grasshopper study.

The African assistants, whose normal work it was to collect and count Red Locusts, tended to ignore them when sent out to collect grasshoppers and were instructed to avoid the denser patches which would have yielded locusts and nothing else. The numbers caught cannot therefore be taken as giving a reliable index of the actual num-

bers of locusts present, relative to the total population of Acrididae, but only of their distribution in the different habitats. The numbers caught in the different habitats are shown in Table 9. The table ends in July as by then the population was fairly low and stable, although this does not happen every year. In general the species is confined to the grassland; of the 1803 specimens taken only 3 % were within the fringing woodland. This percentage consisted of one female and 54 nymphs and from many observations this is known to be due to the fact that at the beginning of the breeding season, usually in November, there is a considerable redistribution of the population and some females move into the fringing woodland and lay their eggs there. *Nomadacris* is only found within the woodland during the breeding season, except when the population is very high, actively concentrating and moving in swarms when the woodland is commonly used for roosting and movement over it must take place before a swarm can leave the valley. Of the specimens taken in the grassland 74.5 % were caught in *Echinochloa,* 14.5 % in *Diplachne,* 7.5 % in *Sporobolus* and 0.5 % in *Hyparrhenia.* This distribution, particularly the fact that the highest population is found in *Echinochloa,* is borne out by many other observations and the *Echinochloa* habitat is usually regarded as the most dangerous for swarm formation. It will be noted from the table that the *Diplachne* habitat comes second; the majority of the specimens caught there were nymphs, few adults remaining in the habitat. The area of this habitat is very large (some 250 square miles) and it can produce unexpectedly high parental populations for the following season, although this may not be apparent, because of the low adult population density.

The colour of the hoppers varies from green, typical of the solitary phase, through yellow to red and black, which is characteristic of the gregarious phase. These colours were recorded as 'green' or 'brown' for all the hoppers taken, and the percentages of each colour for the different habitats are given in Table 10. In the *Echinochloa* and *Diplachne* habitats the vast majority of the hoppers showed colouration of the gregaria type. This agrees with the previous remarks, namely that *Echinochloa* is known to be the most dangerous habitat and that in *Diplachne* a large proportion of the considerable hopper population actively moves out as soon as the adults emerge; usually they move to the *Echinochloa* habitat. The majority of the hoppers

in the other habitats were green, suggesting a much more solitary existence and showing that these habitats are less likely to act as primary concentration zones.

Adults were caught in all months from March to January, hoppers from January to April and egg pods were obtained from November to January. The species has a single generation per year, the adults surviving the dry season.

Work was done on the reproduction of the Red Locust (Robertson, 1958) during which a considerable number of ovaries were examined. The results for 1955-1956 are given in Table 11. Development was only found from November to January, when only a few were examined because by the middle of the month most of the adults died.

The number of ovarioles in the three specimens counted ranged from 75 + 79 to 89 + 86, the average total being 164. This is considerably higher than the average number of 92 eggs per pod suggested in Robertson (1954) although it falls within the range given for numbers of eggs per pod in Chapman and Robertson (1958). Three ovaries were carefully examined to give an indication of the proportion of eggs which do not develop normally and from 5.2 to 16.6 % of the ovarioles did not contain well developed eggs (Table 12). This requires further investigation, but it is considered possible that when a female has laid more than one egg pod the percentage of degenerate ovarioles may increase.

Ornithacris cyanea cyanea (Stoll).

This was the largest of the local species and with its purple hind wings was very distinctive. It was however very wary and a very strong flier so that it was not easy to catch and our results tend to show it to be more uncommon that it really was. A total of 16 specimens were caught from all the habitats, 87.5 % in the grassland and 12.5 % in the woodland.

Adults were caught from May to January and egg pods were obtained in November and December when females with developing ovaries were also examined. The species has a single generation per year, the adults surviving the dry season.

Ovary length reached 24.0 mm. with eggs in ovarioles 5.0 mm. long, but they were not fully developed. Ovariole number 65 + 64 to 93 + 95 (3), average 164.

Acanthacris ruficornis lineata (Stoll).

A forest dwelling species, only one specimen being obtained in the grassland, from *Echinochloa*. Adults and egg pods were obtained in November and December, adults and nymphs in March.

Cyrtacanthacris aeruginosa aeruginosa (Stoll).

The distribution is shown in Table 13. A total of 117 specimens were caught and of these 23.5 % were taken within the woodland habitats and 76.5 % in the grassland. Within the grassland 56 % were taken in *Sporobolus,* 38 % in *Echinochloa* and the other 6 % were distributed fairly equally in *Diplachne* and *Hyparrhenia*. The high proportion caught in *Sporobolus* results largely from the fact that the nymphs, which are dull green and very unlike the adult, were almost solely confined to *Sesbania tetraptera* as a food plant and most of the *Sesbania* was growing amongst the *Sporobolus*.

Adults were taken from February to June, hoppers from January to March and egg pods were obtained from March till May and were dug up in the field in December. The species thus has a single generation per year, with an egg diapause during the dry season.

Cyrtacanthacris tatarica tatarica (L.).

A single adult was caught in the fringing woodland in December.

Eyprepocnemis plorans meridionalis Uvarov.

This was the commonest of the large grasshoppers and from Table 14 it will be seen that the great majority came from the grasslands; 1572 specimens were caught, but only 0.5 % came from the woodland.

In the grassland 32.5 % came from *Echinochloa*, 24 % from both the *Sporobolus* and the *Hyparrhenia* and 19 % from *Diplachne*.

Adults were taken in every month except February, hoppers from January to November and egg pods were obtained in December and January and from March to June. Developing ovaries were found from March to May and in October and December (Table 15), but from July to September they were undeveloped. This may indicate that the species has a single generation per year with a very extended breeding season, but it is more likely that there is a second generation, the parental population laying eggs from November onwards and the resulting adults becoming mature and laying eggs from February and March to June. The progeny of this second generation would then remain alive throughout the dry season; there would be some overlap between generations and it seems possible that hoppers hatching from eggs laid in June and July could have a very extended period of development due to adverse conditions. Antoniou and Hunter-Jones (1956) working in the laboratory with a stock of *Eypropocnemis* from the Rukwa concluded that it was possible to obtain three generations per year, the grasshoppers being bred at temperatures between 28° and 36° C. They did not obtain a diapause at any stage of the life cycle, but in the field adults emerging in July do not mature until October or November. Similarly, it has been shown (Albrecht, 1953), that in cages more than one generation per year of *Nomadacris* can be obtained, although *Nomadacris* certainly has an adult diapause in the Rukwa. Joyce (1952) observed that *E. ibandana* bred continuously in the Sudan and that *E. noxius* had two generations; he also recorded 4th and 5th instar hoppers of *E. noxius* throughout the dry season.

Maximum ovary length 23.5 mm. with eggs in ovarioles 5.5 mm. long. Eggs in oviducts 4.5-5.5 mm. long. Ovariole number 31 + 33 to 52 + 48 (17), average 82.

Cataloipus oberthuri I. Bol.

Common throughout the grassland in the first half of the year (Table 16), only 3 % of the total were caught in the woodland. In the grassland 42 % were taken in *Echinochloa*, 20 % in *Diplachne*, 27 %

in *Sporobolus* and 8 % in *Hyparrhenia*. From Table 16 it seems that the adults die off in June and July and there is an indication that the females die earlier than the males.

Adults were taken from March to July, hoppers from January to March. Developing ovaries were examined in March and April and egg pods were obtained from April to July; they were also dug up in the field at the end of the dry season and at the beginning of the wet season in the absence of any adults. The species therefore has one generation per year, with an egg diapause during the dry season.

Ovary length reached 21.5 mm. with eggs in ovarioles and oviducts 5.5 mm. long. Ovariole number 68 + 63 to 90 + 91 (10), average 148.

Tropidiopsis sp.

A total of 154 specimens were taken (Table 17), 23 % in the grassland, 32 % in the fringing woodland and 45 % on the side of the escarpment. All the specimens caught in the grassland were hoppers, the adults being confined to the woodland. This may suggest a temporary spreading out of the adults to find suitable egglaying sites, although none was taken at the beginning of the breeding season, that is at the end of the rainy season. The hoppers of this species were very similar to those of *Tylotropidius speciosus*. Although *Tropidiopsis* is brachypterous it is very agile and difficult to catch, especially in the thick vegetation which it favours, as its habit when disturbed is to jump and then drop and run along the ground.

Adults were taken from March to July, hoppers from January till May and egg pods were obtained in April and May. Three developing ovaries were examined in March. Although no egg pods were obtained in the field it seems likely that the species has a single generation per year with an egg diapause during the dry season.

The length of the ovaries reached 8.5 mm. although the eggs in the ovarioles had not reached full development. Ovariole number 19 + 21 to 23 + 22 (3), average 43.

Tylotropidius gracilipes Brancs.

This is essentially a woodland species; of 21 specimens caught only one was found in the grassland. Within the woodland 65 % came from the fringing woodland and 35 % from the side of the escarpment. This species is characterised by the very long hind femora which are used to good effect when the insect is disturbed.

Adults were taken from June to December, late instar hoppers were caught in June and egg pods were obtained from July to September and in November. Ovaries were examined from September to December and development was found in all these months. It seems probable that there is a single generation per year with some departure from the usual cycle in that the adults, emerging at the end of the wet season, mature quickly and lay eggs throughout the dry season. Joyce (1952) states that the adults can survive the dry season, but are not found in the wet season.

Maximum ovary length 20.5 mm. with eggs in ovarioles and oviducts 5.0 mm. long. Ovariole number 18 + 19 to 28 + 28 (14), average 49.

Tylotropidius speciosus (Walk.).

This was one of the more common species in the grassland. A total of 384 specimens were taken and of these only 1 %, all hoppers, were taken within the woodland. In the grassland habitats 58 % were taken in *Sporobolus*, 24.5 % in *Echinochloa*, 13.5 % in *Diplachne* and 4 % in *Hyparrhenia*.

Adults were caught in every month except February and April, hoppers from January till June and egg pods were obtained in September, October, January and February. Developing ovaries were found from August to December (Table 18). The species therefore has a single generation per year, with some departure from the usual cycle in that the first eggs are laid before the beginning of the wet season, at a time when the soil might be expected to be at its least favourable for egg laying.

Maximum ovary length 20.0 mm. with eggs in ovarioles 5.5 mm. long. Eggs in oviducts 4.5-6.0 mm. long. Ovariole number 26 + 26 to 44 + 45 (62), average 63.

Subfamily — OEDIPODINAE.

Aiolopus femoralis Uvarov.

Few specimens were caught, mostly within the woodland. Adults were taken in March, June and December and development of the ovaries was noted in five specimens in December.

The length of the ovaries reached 9.0 mm. and of the eggs 4.5 mm., at which length they were lying in the oviducts.

Aiolopus longicornis Sjöst.

Specimens were found throughout the year, but only in the grassland. A total of 63 specimens were taken, the majority being in the *Sporobolus* and *Hyparrhenia*. Adults were taken from January to November. Egg pods were found in February and in March the ovaries of 13 specimens were examined and all showed development. Maximum ovary length 12.0 mm. with eggs in ovarioles 4.0 long. Ovariole number 12 + 12 to 21 + 22 (9), average 31.

Aiolopus sp.

This is a species often referred to as *Aiolopus thalassinus*, but we are advised by Dr. Dirsh that as the genus requires revision it is preferable to leave it without a firm identification.

A total of 477 specimens were caught of which 55 % were taken in the woodland and 45 % in the grassland so that there was a fairly even distribution throughout the habitats. The majority of hoppers were caught during May and June and the catch of adults was highest in July.

Adults were caught from March to January and hoppers from March to July. Ovaries showing development were examined in

March, April, July and August. Egg pods, which in Chapman and Robertson (1958) are incorrectly attributed to *A. thalassinus,* were obtained in January, May and June. This may indicate a single generation per year with an extended breeding season, but more probably suggests continuous breeding during the wet season involving two or more generations.

The ovaries reached a length of 9.0 mm. with eggs in the ovarioles 4.0 mm. long. Ovariole number 13 + 15 to 20 + 21 (6), average 31.

Morphacris fasciata (Thunb.).

Most specimens were caught within the woodland habitat (Table 19) and from a total of 753 specimens only 1 % came from the grassland while 21 % were from the fringing woodland and 78 % from the side of the escarpment. For most of the year this was the commonest species on the side of the escarpment.

Adults were taken in every month, hoppers in January, March, and May to September. Egg pods were obtained from April to June and in December, while adults with well-developed ovaries were examined in March, July, August and December. Those examined in September and October were immature (Table 20). It seems likely that there are two generations per year. Egg pods are laid at the beginning of the wet season and develop at once. Adults appear from January to March, mature quickly and lay eggs from March to August, these eggs again developing without a diapause. The resulting adults, emerging from June onwards, do not begin to lay eggs until the wet season begins, usually in November (cf. Table 19).

Maximum ovary length 13.0 mm. with eggs in ovarioles 4.5 mm. long. Eggs in oviducts 4.0-5.0 mm. long. Ovariole number 15 + 14 to 23 + 21 (11), average 37.

Trilophidia angustipennis (Kirby).

Specimens were taken in both the grassland and woodland habitats, 40 % being taken in the grassland, 55 % in the fringing woodland and 5 % on the side of the escarpment. Within the grassland

3 % were in *Sporobolus,* 10 % in *Echinochloa,* 31 % in *Diplachne* and 56 % in *Hyparrhenia.* When flying this species is easily seen, having bright yellow hind wings, although when on the ground, the body being black, it is difficult to detect.

Adults were caught in January, March and from May to December, hoppers from March to May. Developing ovaries were examined in March and December, and egg pods were obtained from November to February.

The length of the eggs in the ovarioles reached 4.0 mm., at which length in two specimens the eggs were in the oviducts. The number of ovarioles in the single specimen examined was 13 + 13.

Trilophidia conturbata (Walk.).

A single adult female was caught in December in the *Hyparrhenia* habitat. The length of the eggs in the ovarioles was 4.0 mm.

Acrotylus patruelis (H.-Sch.).

This species was usually found in close association with patches of bare ground; when at rest it is difficult to detect and when disturbed the flight is rapid, the insect only being followed by the sight of the red hind wings. The species was mainly associated with the woodland habitats (Table 21), 73.5 % of the total numbers being caught in the woodland. In the 26.5 % caught in the grassland more than half came from the *Hyparrhenia* which was adjacent to the woodland.

Adults were found in every month, hoppers were taken from January to August and egg pods were obtained in February, September, November and December. Developing ovaries were found in March, July and December, but no development was found in August. This suggests that there are at least two generations per year (Table 21).

Acrotylus variegatus Brancs.

A total of 157 specimens were taken, of which only 1.5 % were caught in the grassland habitats; 95 % were taken in the fringing woodland, the majority being in association with areas of native cultivation, and 3.5 % on the side of the escarpment. The great majority of specimens were caught in August, when the bush fires had made collecting much easier.

Adults were caught in January, March and July to October; hoppers only in August. Ten ovaries were examined during August and four showed signs of some development.

In Uvarov (1953) the presence of an extrusible bladder at the rear of the pronotum is discussed. It was found that while this bladder was present in both the species of *Acrotylus* obtained it was perhaps slightly larger and more readily extruded in *A. variegatus*.

Oedaleus nigeriensis Uvarov.

The vast majority of adults of this species were collected in the woodland habitats (Table 22). There were very few adults from February to April, but nymphs were abundant, particularly in the grasslands in the *Echinochloa* habitat. This may suggest a scattering of mature adults in January to seek suitable egg-laying sites. When adults became common again in May none was taken in the grassland despite the abundance of nymphs there and this may indicate a movement of immature adults back into the woodland. This might be related to changes in the availability of food or a lack of suitable oviposition sites for the second generation on the rapidly drying grasslands.

Adults were taken from April to July and from November to February, hoppers from March to July and egg pods were obtained in January, May and June. A female with a well-developed ovary was collected in December. The species is, therefore, likely to have two generations per year. Eggs were laid in December and January and nymphs became common by March giving rise to a new adult generation in May and June. At least some of these oviposited before

disappearing in August, but no large numbers of nymphs or adults were then collected until the reappearance of adults in November. It is impossible to decide from these data whether the species survived the dry season as an adult, or in the egg, or as both.

One ovary was examined and its length was 7.5 mm. with eggs in the ovarioles 4.0 mm. long and the number of ovarioles 18 + 19.

Humbe tenuicornis (Schaum).

Of the 222 specimens caught 6 % were from the grassland, 13 % from the fringing woddland and 81 % from the side of the escarpment (Table 23).

Adults were taken throughout the year, hoppers from January till June and egg pods were obtained from January to March and in May and June; also, developing ovaries were found in March, August and September. From this it seems that the life history is complicated. From August to December only adults were caught, but during this period developing ovaries were found and eggs probably laid. At the beginning of the rains the egg pods develop and hatch, but some of the adults presumably live on and continue laying until January, so that the hopper season is extended. Then the new adults emerging in February and March mature quickly and begin to lay eggs. It is probable that some of the eggs laid at the beginning of the wet season hatch and produce a small second generation, the adults of which do not emerge until July. Presumably any eggs laid after the end of the wet season do not hatch until the next wet season. It may be that there is a complete second generation, but it seems rather unlikely from the available evidence. It seems also from the evidence of the developing ovaries, that eggs are laid throughout the dry season as well as in the wet season.

Ovariole number 20 + 21 to 28 + 26 (10) average 47.

Gastrimargus africanus (Sauss.).

The species was widespread, but never very common. A total of 115 specimens was caught, 72 % from the grassland, 11 % from the fringing woodland and 17 % from the side of the escarpment. Wi-

thin the grassland 11 % were taken in *Sporobolus,* 8 % in *Echinochloa,* 11 % in *Diplachne* and 70 % in *Hyparrhenia.*

Adults were taken in all months except June and July, hoppers from January till August and egg pods were obtained in January, February, July and September. This may indicate two generations per year, but the evidence tends to point to a complex life history, adults of very different ages being present at one time. The egg pods laid during the dry season hatch at the beginning of the rains, but it also seems likely that the adults which emerge from the hoppers taken in June to August would live through the dry season and lay eggs in the wet season. From the months when egg pods were actually obtained and the presence of adults with well-developed ovaries in March and from September to November it appears that the adults reach maturity quickly and lay eggs throughout their lives.

Maximum ovary length 15.0 mm. with eggs in ovarioles 4.5 mm. long. Eggs in oviducts 5.0 mm. long. Ovariole number 38 + 38 to 43 + 40 (4) average 79.

Locusta migratoria migratorioides (R. & F.).

This species, the Migratory Locust, was confined to the grassland. In some years, particularly from March to May, there are very many *Locusta* in the Rukwa Valley, a parallel being found in the Middle Niger, where Red Locusts are found in the *Locusta* outbreak area. In 1956 however, only 26 specimens were taken so that little reliance could be placed on distribution figures. They were found in all grassland habitats, most being taken in *Sporobolus* and least in *Hyparrhenia.*

Adults were taken from January to March, in May, June, August and November, hoppers from March to June and egg pods were obtained from May to July. Females also had well-developed ovaries in March. Previous observations indicate that there are two generations per year. Egg pods are laid at the beginning of the rainy season and the adults which emerge lay egg pods from May to July. These eggs develop without a diapause and the resulting adults then live until the beginning of the wet season. Joyce (1952) found two generations per year in the Sudan.

The length of the ovaries reached 20.0 mm. In one specimen eggs 6.0 mm. long were lying in the oviducts. Ovariole number 49 + 47 and 55 + 54 (2).

Paracinema tricolor tricolor (Thunb.).

The species was restricted to the grassland, only a single specimen being taken within the woodland. 95 % of those caught came from *Echinochloa,* but isolated specimens were also caught in *Diplachne* and *Hyparrhenia.* The first hoppers were found towards the end of the dry season and presumably they fed on the grass regenerating after grass fires.

Adults were taken from November to March, hoppers in October and November and egg pods were obtained in February and November. The species probably has a single annual generation.

Ovaries were examined in November and their length reached 14.5 mm. with eggs in ovarioles and oviducts 4.5 mm. long. Ovariole number 53 + 56 to 79 + 74 (4), average 139.

Subfamily — **TRUXALINAE.**

Gymnobothrus gracilis (Ramme).

58.5 % of the specimens were taken in the fringing woodland and 21.5 % on the side of the escarpment. In the grassland 18.5 % were taken in *Diplachne* and 1.5 % in *Hyparrhenia.* Most of the specimens caught in the grassland were, however, hoppers and during the six months of the dry season only one adult was taken in the grassland.

Adults were taken throughout the year except for May, hoppers in January and February and egg pods were obtained in November. Developing ovaries were examined in March and November.

Maximum ovary length 7.5 mm. with eggs in ovarioles and oviducts 3.5 mm. long. Ovariole number 6 + 7 to 9 + 10 (5), average 17.

Gymnobothrus temporalis temporalis (Stål).

The species was common in both grassland and woodland although the majority were concentrated at the edge of the woodland. A total of 242 specimens was taken, 13 % in *Hyparrhenia,* 64 % in the fringing woodland and 19 % on the side of the escarpment. The remaining 4 % were scattered through the *Sporobolus, Echinochloa* and *Diplachne* habitats.

Adults were caught from June to January and egg pods were obtained in November and December when females with well-developed ovaries were also found. It thus seems possible that the species has a single generation per year.

Ovary length reached 9.5 mm. with eggs in ovarioles and oviducts 4.0 mm. long. Ovariole number 9 + 10 to 11 + 13 (7), average 21.

Gymnobothrus sp.

This species was not differentiated in the field, being very similar in appearance to *G. gracilis.* Eleven specimens were caught, from August to October, all in the woodland habitats.

One ovary in August showed little signs of development; the number of ovarioles was 9 + 8.

Rhabdoplea sp.

Five specimens were taken in September, all within the fringing woodland. The species is very active and difficult to catch in dense vegetation so that it was very difficult to estimate how common it really was.

Duronia tricolor (Karny).

The species was quite common and was caught in all the habitats. A total of 450 specimens was taken, 6 % in *Sporobolus,* 32 % in *Echinochloa,* 15 % in *Diplachne,* 32 % in *Hyparrhenia,* 10 % in the fringing woodland and 5 % on the side of the escarpment. Adults

were taken from May to July and from October to January, hoppers in July, November and December and egg pods were obtained in June, July, November and December. Developing ovaries were examined in June, November and December. The species has two generations per year. Egg pods begin to develop in the dry season and some adults have already emerged when the wet season begins. These adults then lay eggs in November and December; the eggs hatch and produce a second generation of adults which lay eggs in June and July. These eggs hatch and the hoppers are present at the end of the dry season, in what would seem to be very adverse conditions. Presumably they feed on the grass which regenerates after the fires. It appears that the May to July generation is smaller than the November to January generation.

Maximum ovary length 18.5 mm. with eggs in ovarioles and oviducts 5.0 mm. long. Ovariole number 26 + 25 to 29 + 30 (9), average 54.

Orthochtha alca I. Bol.

A grassland species, only 2 % being taken in the fringing woodland. 64 % were taken in *Sporobolus* and the remaining 36 % were evenly distributed in the other grassland habitats. Adults were taken from March to June, hoppers from January till April. Sixteen ovaries were examined in March and 63 % were developing and from seventeen examined in April 94 % were developing. Egg pods were obtained in April and May. The species has a single generation per year with an egg diapause over the dry season. Table 24 shows that the majority of the adults had emerged by April and had begun to die off rapidly by June. It is also clearly indicated that in March when the majority of the nymphs were becoming adult the males developed first; of the 183 adults taken only 30 % were females. The species is brachypterous, but is alert and a powerful jumper.

Maximum ovary length 14.0 mm. with eggs in ovarioles and, in April, in oviducts 5.5 mm. long. Ovariole number 14 + 12 to 17 + 17 (23), average 29.

Parga angusticornis Sjöst.

Four specimens were caught in the fringing woodland in September and October. Ovaries were examined but no development was found.

Parga xanthoptera (Stål).

Adults were taken from August to December within the fringing woodland. One ovary was examined in October but showed no development. The number of ovarioles was 6 + 10.

Machaeridia sp.

Few specimens were taken and it seemed that the species was fairly uncommon. The majority were taken in the woodland habitats.

Adults were taken from August to December and egg pods were obtained in November and December.

Cannula linearis (Sauss.).

This grasshopper is very elongate and the colour of dry grass. It is sluggish and spends long periods pressed closely against a stem or leaf of grass, blending with the background very well. Although it seems to be uncommon, it may well not be, its considerable modification for life in tall grass making it very difficult to see.

Nine adults were caught from September to December, mostly in grassland.

Acrida sp.

Three species were obtained, *A. bicolor* (Thunb.), *A. turrita* (L.) and *Acrida* sp., but as they were not differentiated in the field the information obtained, with the exception of that for the actual speci-

mens identified in London, must be given under the heading of the genus.

Less than 3 % came from the woodland habitats (Table 25). In the grassland 54 % were caught in *Diplachne*, 20 % in both the *Echinochloa* and *Sporobolus* and 2 % in the *Hyparrhenia*.

It was noted when collecting started that in all the habitats both green and brown hoppers were caught, the green ones being in the majority; as development progressed, the proportion of brown hoppers decreased, but the cause of this remained unknown. The average ratio of green/brown for all the habitats was 6.5, but there were no obvious differences between the habitats.

In all three species the life history seemed to follow the same pattern. Hoppers were found from December to June, although an isolated 5th instar nymph was taken in October, adults from March to September and egg pods were laid from April to August and dug up in the field from November to February. There is evidence from the dissection of ovaries and because egg pods were found in the ground at the end of the dry season that there is an egg diapause. The adults begin to die off rapidly in July and there is clearly only one generation each year. Another fact indicated in Table 25 is that in March, when the adults begin to emerge, the males emerged first; by April however the sex ratio was fairly even. This difference may be related to the fact that the females are much larger than the males, and so take longer to develop.

Acrida bicolor (Thunb.).

A grassland species, only three out of a total of 39 identified were caught in the forest edge. 19 developing ovaries were examined from April to September and their length reached 25.0 mm., the eggs in the ovarioles reaching a length of 5.5 mm. Ovariole number 42 + 46 to 52 + 54 (11), average 99.

Acrida turrita (L.).

A grassland species, only two out of a total of 29 specimens identified being caught within the woodland.

Acrida sp.

Two females were caught within the forest edge in June. The ovaries were well developed, their lengths being 16.5 mm. and 19.0 mm. respectively with eggs in ovarioles 3.5 mm. and 6.0 mm. The number of ovarioles was 51 + 52 and 49 + 48 respectively.

Aulacobothrus wernerianus (Karny).

Very common in the grassland although very few specimens were caught until August when most of the grassland was burnt. After burning there seemed to be a concentration at the edge of the unburnt grass, many being flushed from the burnt area and returning to the unburnt grass. Only 1.5 % came from the woodland and the distribution within the grassland was fairly even, the smallest number coming from the *Echinochloa*.

Adults were caught from July to January and egg pods were obtained in November. It seems likely that there is a single generation per year.

Fourteen ovaries were examined in November and December, their lengths reaching 6.0 mm. with eggs in ovarioles and oviducts 3.5 mm. long. Ovariole number 11 + 11 to 14 + 13 (4), average 24.

Aulacobothrus sp.

One specimen was caught in August, in the fringing woodland.

Faureia coerulescens Miller.

Specimens were taken in all the habitats. There seemed to be an increase in numbers as the dry season advanced, but this was considered to be because they were difficult to catch in the dense vegetation before the fires in August. A total of 454 specimens was taken, 18 % in *Sporobolus*, 25 % in *Echinochloa*, 10 % in *Diplachne*, 39 % in *Hypar-*

rhenia and 4 % in both the fringing woodland and on the side of the escarpment.

Adults were taken from May to January and egg pods were obtained in November. Developing ovaries were examined from October to December. The species has a single generation per year.

Maximum ovary length 12.0 mm. with eggs in ovarioles and oviducts 4.0 mm. long. Ovariole number 8 + 9 to 10 + 10 (10), average 18.

Dnopherula crucigera Uvarov.

This species was confined to the woodland habitats, 11 % being taken in the fringing woodland and 89 % on the side of the escarpment.

Adults were taken from September to January and egg pods were obtained in November.

Ovaries were examined in November and December and their length reached 9.0 mm. with eggs in ovarioles 3.5 mm. long. Ovariole number 12 + 13 to 15 + 14 (3), average 27.

Dnopherula marshalli Miller.

A single adult was taken in the fringing woodland in December.

Pnorisa squalus Stål.

This species was widespread and fairly common in all the habitats, although the majority were taken in the grassland. A total of 228 specimens was caught, 18 % in *Sporobolus,* 13 % in *Echinochloa,* 34 % in *Hyparrhenia,* 16.5 % in *Diplachne,* 12 % in the fringing woodland and 5.5 % on the side of the escarpment.

Adults were taken in March and from July to January, hoppers in March and egg pods were obtained from September to November. The eggs were thus laid before the end of the dry season when the ground seemed to be very unsuitable.

Ovaries were examined from November to December and their

length reached 12.0 mm. The eggs in the ovarioles reached a length of 4.0 mm. and at that length and above (4.5 mm.) in some specimens they were lying in the oviducts. Ovariole number 16 + 18 to 20 + 18 (5), average 36.

Afrohippus leai Uvarov.

This very common species was almost confined to the grassland (Table 26) and only 4 % of 8762 specimens were caught within the woodland, a single specimen only being taken on the side of the escarpment. Within the grassland 52 % were caught in *Sporobolus*, 39 % in *Echinochloa*, 6 % in *Diplachne* and 3 % in *Hyparrhenia*. Table 26 shows that when the adults began to emerge the smaller males emerged first, considerable numbers being caught in February, while the larger females were not present in any great numbers until March.

This species, originally described from the Rukwa Valley and subsequently found in other low lying swampy grasslands in Tropical Africa, was also present in considerable numbers on grazing land on the Ufipa Plateau at an altitude of about 7000 feet, although virtually absent on the wooded escarpment separating the plateau from the valley grasslands.

Hoppers were caught from January till April, adults from February to June. In February only one developing ovary was examined, but in March and April all those examined were well-developed. Egg pods were laid in March and April and were also dug up in the field from November to January. This indicates that there is an egg diapause throughout the dry season.

The length of the ovaries reached 11.5 mm. with eggs in ovarioles 4.5 mm. long. Ovariole number 13 + 11 to 16 + 14 (22), average 26.

Mesopsis laticornis (Krauss).

The species was almost confined to the grassland, only a single specimen being taken within the fringing woodland. 52 % were taken in *Sporobolus*, 16 % in *Echinochloa*, 7 % in *Diplachne* and 25 %

in *Hyparrhenia*. It is straw yellow in colour with an elongate head and body and is well adapted for living in tall grass. When sitting motionless it is difficult to detect and the normal behaviour on disturbance is to move round a grass stem away from the disturbance rather than to fly immediately.

Adults were taken from June to December and egg pods were obtained in November.

One ovary was examined in December; its length was 10.0 mm. with eggs in ovarioles 3.5 mm. long. The number of ovarioles was 23 + 23.

Truxalis burtti (Dirsh).

Specimens were caught in all the habitats, except the side of the escarpment. 41 % came from *Sporobolus*, 24 % from *Echinochloa*, 20 % from *Diplachne*, 2 % from *Hyparrhenia* and 13 % from the fringing woodland.

Adults were taken from March to July and from October to January, hoppers in April and October and egg pods were obtained in May and from August to October. These data suggest two generations per year.

Egg pods hatch at the end of the dry season and the adults which emerge lay eggs in May. These eggs then develop and the adults which emerge lay eggs in the middle of the dry season. The data obtained are few and it appears that there is a considerable overlap between generations.

Breeding cycles.

The breeding of most species of grasshoppers in the Rukwa Valley was affected to a greater or lesser extent by the prolonged dry season. The most complete adaptations were shown by those species which survived the dry season in the egg or as an immature adult and in *Nomadacris* this has been shown to be a true diapause (Norris, 1959). This is probably equally true of other species. Those shown in Table 27 survived the dry season in the egg stage and there were probably others, *Acrida turrita* for instance; those in Table 28 survived as

adults, known to be immature in some cases, such as *Acanthoxia* and *Nomadacris,* and probably so in the others. The species not included in these tables are those in which either there is too little data or which survived the dry season in more than one stage. For instance, both adults and nymphs of *Eyprepocnemis* and adults and eggs of *T. gracilipes* were present throughout the dry season and this may indicate that these species would continue to breed so long as favourable conditions could be found in some part of their habitat. In the absence of suitable conditions development might be suspended, but this might occur at any stage and almost certainly is not to be regarded as a diapause. All types of development were found in the four major subfamilies except that no Pyrgomorphinae survived the dry season as adults and no Oedipodinae survived as eggs.

In Table 29 thirty seven species are recorded for which the number of annual generations is known with some certainty. Of these, 26, including most of the Catantopinae and Truxalinae, had only a single generation per year and only two species, *Chrotogonus* and *Pyrgomorpha,* almost certainly had three. The majority of the Oedipodinae had two generations.

Ovariole number.

The data on ovariole number are collected together in Table 30 where they are compared with Waloff's (1954) data from the Rukwa, collected in 1952, and with the numbers of eggs obtained in egg pods by Chapman and and Robertson (1958). Mean values are not given because the various data were collected at different times of year and so were not drawn from single populations in the statistical sense.

In all cases the correspondence in ovariole number between Waloff's data and the present figures is very good, but this is not always true of the numbers of eggs in egg pods. Here in 9 out of 36 cases the maximum number of eggs in a pod is less then the minimum recorded number of ovarioles and in 13 others the maximum number of eggs is very little more than the minimum number of ovarioles. This marked difference between the potential and actual numbers of eggs in the same population (since both sets of data were collected at the same time) must presumably be related to degeneration and failure of eggs to develop prior to oviposition such as is indicated for

Nomadacris in table 12. In this case the degeneration might be related to ageing, but Phipps (1959) has shown that in *Trilophidia conturbata* degeneration results from starvation. Probably many other factors are also involved and the present data suggest that it is relatively unusual for the breeding potential of grasshoppers to be fulfilled. Only in isolated specimens of *Catantops melanostictus* and *Orthochtha alca* were significantly more eggs obtained in a pod than in the ovarioles. Phipps (1959) has suggested that this could arise from successive ovulations without any intervening oviposition.

Phipps also remarks that there may be geographical differences in ovariole number in a particular species and this is apparent from a comparison of his data with those given here. In 8 out of 17 instances where the same species were studied the minimum ovariole number in the Rukwa was greater than the average figure given by Phipps for specimens from more northern parts of Tanganyika. In the remaining cases Phipps' averages fell within the Rukwa range and in no instance was his average greater than the Rukwa maximum.

The sizes of eggs in the oviduct could also be compared in a few cases and in 5 species the Rukwa figures were comparable with Phipps', but in *Phaeocatantops* and *Cataloipus* the eggs obtained by Phipps were larger, thus agreeing with his statement (1959, p. 53) and providing further evidence of geographical variation. In this respect it is also interesting to compare the *Paracinema tricolor tricolor* (Trunb.) from the Rukwa with over 100 ovarioles with *P. t. bisignata* from France, which has only 40 (Waloff, 1954). This may suggest internal differences much greater than would be suggested by a subspecific difference based on external characters.

Both Waloff (1954) and Phipps (1959) find the average number of ovarioles per millimeter of body length to be relatively greater in larger than in smaller grasshoppers. The average number of ovarioles per mm. body length are given in Table 30 and a regression of ovariole number against body length can be plotted, but from the present data only that for Truxalinae and possibly that for the Oedipodinae is statistically significant. These regressions are:

Truxalinae $y = 37.9 + 1.35\ (x\text{-}33.1)$, $0.001 > P$

Oedipodinae $y = 55.1 + 2.6\ (x\text{-}31.6)$, $0.05 > P > 0.01$ where y = ovariole number and x = body length in mm.

The number of ovarioles per millimeter of body length also varies

according to the subfamily as the above regressions indicate. Table 31 suggests that this may also be true of the other subfamilies and suggests that for a particular size Pyrgomorphinae tend to have most ovarioles followed by Catantopinae, Oedipodinae and Truxalinae in that order. Similar trends are indicated by Waloff (1954) and Phipps (1959) although the differences may not be statistically significant.

Distribution relative to vegetation.

Table 32 shows the distribution of species of the major subfamilies relative to the vegetation. Overall, allowing an overlap of 5 % for occasional records, 19 species occurred only on the grasslands, 26 within the woodland and 25 were common to both. The Pyrgomorphinae were only found in the woodland, but among the other subfamilies some species were common to both grassland and woodland while others were confined to one or the other habitat. There is a suggestion that the variety of species was slightly greater in the woodland than in the grassland (51 compared with 44 species) and, in view of the much greater variety of habitats in the woodland, it is probable that the difference was greater than is indicated by these figures. On the other hand, numbers of grasshoppers were much greater on the grasslands than in the woodland, as is indicated by the distribution tables of the individual species.

The commoner grassland species were generally fairly evenly distributed throughout the *Sporobolus* and *Echinochloa* habitats, eight species being found most commonly in the *Sporobolus* and six in the *Echinochloa,* but two of these, *Nomadacris* and *Paracinema* were very much more abundant in the *Echinochloa* than elsewhere. 74 % of all the *Nomadacris* and 95 % of the *Paracinema* were collected in this habitat. *Echinochloa* is believed to have some significance for *Nomadacris* as a focus for concentration and is greatly preferred as a food plant (Chapman, 1957) while *Paracinema* is typically found in very moist situations and *Echinochloa* is normally found along rivers and in other wet localities. *Acrida* was commoner in the *Diplachne* than in any other habitat, but it was the only abundant species from this grass. Four species were found most commonly in *Hyparrhenia,* but of these only *Gastrimargus* was at all restricted in its distribution.

The others, *Duronia, Faureia* and *Pnorisa,* were widespread and were also common in the other grassland habitats. *Catantops melanostictus, Trilophidia angustipennis* and *Acrotylus patruelis,* commonly found in the woodland, were also sometimes found in the *Hyparrhenia* which was adjacent to it.

Summary.

A short summary is given of the conditions prevailing in the Rukwa Valley, S. W. Tanganyika, with a description of the major habitats in which grasshoppers were found. A total of 71 species of grasshoppers was taken and details are given of the distribution of the species within the different habitats, the life history, and the number of ovarioles produced.

Breeding was affected by the prolonged dry season and many species survived this period as immature adults or as eggs. Some species appeared to breed continuously wherever suitable conditions were available.

There was a marked difference between the numbers of eggs in ovarioles and the number found in egg pods suggesting that some degeneration of oocytes normally occurs. Comparison of the data with that of Phipps (1959) suggests some geographical variation.

There was rather more variety of species in the woodland than the grassland.

Acknowledgements.

We wish to thank Dr. V. M. Dirsh, Anti-Locust Research Centre, London, who kindly identified our specimens and Mrs. B. M. Chapman who gave us considerable assistance. We also wish to record the hard work done by our several African assistants without whom much of the data could not have been collected.

References.

ALBRECHT, F. O.

1953. The breeding of the Red Locust in captivity. *Bull. ent. Res.* 44, 1-4.

ANTONIOU, A., & HUNTER-JONES, P.

1956. The life history of *Eyprepocnemis capitata* Miller (Orth, Acrididae), in the laboratory. *Ent. mon. Mag.* 92, 364-368.

CHAPMAN, R. F.

1957. Observations on the feeding of adults of the Red Locust (*Nomadacris septemfasciata* (Serville)). *Brit. J. Anim. Behav.* **5**, 60-75.

CHAPMAN, R. F., & ROBERTSON, I. A. D.

1958. The egg pods of some tropical African grasshoppers. *J. ent. Soc. Sthn. Afr.*, **21**, 85-112.

GOLDING, F. D.

1948. The Acrididae (Orthoptera) of Nigeria. *Trans. R. ent. Soc. Lond.* **99**, 517-587.

GUNN, D. L.

1956. A history of Lake Rukwa and the Red Locust. *Tanganyika notes and records* No. 42, 1-18.

JOHNSTON, H. B.

1956. *Annotated Catalogue of African Grasshoppers.* C. U. P. (22 +) 833 pp.

JOYCE, R. J. V.

1952. The ecology of grasshoppers in East Central Sudan. *Anti-Locust Bull.* No. 11 (2 +), 97 pp.

LEAN, O. B.

1936. *Locusta migratoria migratorioides,* R. & F. An ecological reconnaisance of the suspected Middle Niger outbreak area. *Bull. ent. Res.* **27**, 105-184.

MILNE, G.

1937. Soils from the flood-plain of Lake Rukwa, Tanganyika Territory. Unpublished report of the East African Agricultural Research Station, Ameni.

NORRIS, M. J.

1959. Reproduction in the Red Locust *(Nomadacris septemfasciata* Serville) in the laboratory. *Anti-Locust Bull,* no. 36 (2 +) 46 pp.

PHIPPS, J.

1959. Studies on East African Acridoidea (Orthoptera), with special reference to egg-production, habitats and seasonal cycle. *Trans. R. ent. Soc. Lond.* **111**, 27-56.

PIELOU, E. C.

1952. Notes on the vegetation of the Rukwa Rift Valley, Tanganyika. *J. Ecol.* **40**, 383-392.

ROBERTSON, I. A. D.

1954. The numbers of eggs in pods of the Red Locust, *Nomadacris septemfasciata* (Serville) (Orth. Acrididae). *Ent. mon. Mag.* **90**, 254-255.

1958. The reproduction of the Red Locust *Nomadacris septemfasciata* (Serv.) (Orthoptera, Acrididae) in an outbreak area. *Bull. ent. Res.* **49**, 479-496.

UVAROV, B. P.

1953. Grasshoppers (Orthoptera, Acrididae) of Angola and Northern Rhodesia, collected by Dr. Malcolm Burr in 1927-1928. *Publ. Cult. Cia. Diamant.,* Angola, Lisbon, no. 21, 9-217.

VESEY-FITZGERALD, L. D. E. F.

1955. The vegetation of the outbreak areas of the Red Locust *(Nomadacris septemfasciata* Serv.) in Tanganyika and Northern Rhodesia. *Anti-Locust Bull.* no. 20 (2 +), 31 pp.

WALOFF, N.

1954. The number and development of ovarioles of some Acridoidea (Orthoptera) in relation to climate. *Physiol. comp. et oecol.* **3**, 370-390.

TABLE 1.

The monthly rainfall, monthly averages of maximum and minimum shade temperature in degrees Centigrade from three stations, and the monthly averages of maximum and minimum relative humidity from one station, during 1956.

MONTH	RAINFALL IN INCHES			MAXIMUM TEMPERATURE °C			MINIMUM TEMPERATURE °C			MAXIMUM R. H.	MINIMUM R. H.
	Kapombo	Kafukola	M 10	Kapombo	Kafukola	M 10	Kapombo	Kafukola	M 10	Kafukola	Kafukola
January	6.39	6.36	6.13	24.2	27.9	26.9	18.9	19.2	19.9	94	59
February	11.07	9.45	5.14	25.4	28.4	28.1	19.1	18.4	20.2	94	54
March	11.35	8.65	7.72	26.9	30.5	29.5	19.0	18.5	20.5	94	49
April	6.95	5.30	7.84	26.5	30.3	29.3	18.5	19.2	21.2	94	46
May	0.51	0.58	0.80	27.1	30.6	30.0	17.6	17.6	18.8	92	35
June	NIL	NIL	NIL	27.3	30.3	30.1	15.8	14.5	14.8	88	32
July	NIL	NIL	NIL	27.5	30.5	30.5	14.9	13.2	13.4	85	27
August	NIL	NIL	NIL	29.5	32.9	32.9	17.0	16.3	15.2	70	20
September	NIL	NIL	NIL	30.0	34.6	33.8	19.0	18.3	17.4	67	24
October	NIL	NIL	NIL	31.0	36.2	34.8	20.7	20.4	19.9	73	41
November	5.05	3.65	2.01	29.2	34.2	33.5	20.5	20.8	21.0	90	48
December	10.87	8.34	7.74	25.7	31.5	29.7	18.9	19.8	20.1	99	62

TABLE 2.

A systematic list of the species of Acrididae obtained, showing presence or absence in the six habitats sampled. + indicates presence.

The egg pods of species marked with an asterisk (*) are described in Chapman and Robertson (1958).

Species	Habitats					
	Grassland				Woodland	
	Sporobolus robustus	Echinochloa pyramidalis	Diplachne fusca	Hyparrhenia rufa	Adjacent to grassland	Escarpment
Subfamily **Pamphaginae.**						
1. *Lamarckiana kilosana*				+		
Subfamily **Pyrgomorphinae.**						
2. **Chrotogonus hemipterus*	+				+	+
3. *Phymateus viridipes*					+	
4. *Zonocerus elegans*					+	
5. **Pyrgomorpha dispar*	+			+	+	+
Subfamily **Catantopinae.**						
6. *Leptacris monteiroi*				+		
7. *Acanthoxia gladiator*	+	+	+	+	+	
8. **Afroxyrrhepes acuticercus*						+
9. **Afroxyrrhepes procera*	+	+	+	+	+	+
10. *Anoxyrrhepes prosternalis*						
11. *Anoxyrrhepes* sp.					+	
12. *Homoxyrrhepes punctipennis*		+				
13. *Tristria dimorpha*				+		
14. **Tristia pallida*	+	+	+	+		
15. **Poecilocerastis striata striata*					+	+
16. **Epistaurus* sp.		+	+	+	+	
17. *Bocagella bolivari*	+					
18. **Abisares viridipennis*					+	
19. **Catantops axillaris axillaris*	+	+	+	+	+	+
20. **Catantops decipiens*					+	+
21. **Catantops melanostictus*	+	+	+	+	+	+
22. **Catantops spissus adustus*				+	+	+
23. **Phaeocatantops decoratus decoratus*	+	+		+	+	+
24. **Anthermus viridipes*					+	
25. *Rhytidacris tectifera*					+	
26. **Orthacanthacris humilicrus*					+	
27. **Nomadacris septemfasciata*	+	+	+	+	+	
28. **Ornithacris cyanea cyanea*	+	+	+	+	+	+
29. **Acanthacris ruficornis lineata*		+			+	+
30. **Cyrtacanthacris aeruginosa aeruginosa*	+	+	+	+	+	+
31. *Cyrtacanthacris tatarica tatarica*					+	
32. **Eyprepocnemis plorans meridionalis*	+	+	+	+	+	+
33. **Cataloipus oberthuri*	+	+	+	+	+	
34. **Tropidiopsis* sp.					+	+
35. **Tylotropidius graciiipes*				+	+	+
36. **Tylotropidius speciosus*	+	+	+	+	+	
Subfamily **Oedipodinae.**						
37. *Aiolopus femoralis*				+	+	
38. **Aiolopus longicornis*	+	+	+	+		
39. **Aiolopus* sp.	+	+	+	+	+	+
40. **Morphacris fasciata*	+	+	+	+	+	+
41. **Trilophidia augustipennis*	+	+	+	+	+	+
42. *Trilophidia conturbata*				+		
43. **Acrotylus patruelis*	+	+	+	+	+	+
44. *Acrotylus variegatus*			+		+	+
45. **Oedaleus nigeriensis*	+	+		+	+	+
46. **Humbe tenuicornis*	+		+		+	+
47. **Gastrimargus africanus*	+	+	+	+	+	+
48. **Locusta migratoria migratorioides*	+	+	+	+		
49. **Paracinema tricolor tricolor*		+	+	+	+	
Subfamily **Truxalinae.**						
50. **Gymnobothrus gracilis*			+	+	+	+
51. **Gymnobothrus temporalis temporalis*	+	+	+	+	+	+
52. *Gymnobothrus* sp.					+	
53. *Rhabdoplea* sp.					+	
54. **Duronia tricolor*	+	+	+	+	+	+
55. **Orthochtha alca*	+	+	+	+	+	
56. *Parga angusticornis*					+	
57. *Parga xanthoptera*					+	
58. **Machaeridia* sp.	+			+	+	+
59. *Cannula linearis*	+		+	+	+	
60. **Acrida bicolor*	+	+	+	+	+	
61. *Acrida turrita*	+	+	+		+	
62. *Acrida* sp.					+	
63. **Aulacobothrus wernerianus*	+	+	+	+	+	
64. *Aulacobothrus* sp.					+	
65. * *Faureia coerulescens*	+	+	+	+	+	+
66. **Dnopherula crucigera*					+	+
67. *Dnopherula marshalli*					+	
68. **Pnorisa squalus*	+	+	+	+	+	+
69. **Afrohippus leai*	+	+	+	+	+	+
70. **Mesopsis laticornis*	+	+	+	+	+	
71. **Truxalis burtti*	+	+	+	+	+	

TABLE 3.

A systematic list of the species caught, showing when adults, nymphs and eggs were obtained throughout the year. Only actual records have been used.

A = adult; N = nymph; E = eggs (egg pods in the ground).

SPECIES	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
Subfamily **Pamphaginae.**												
1. *Lamarckiana kilosana*	A											
Subfamily **Pyrgomorphinae.**												
2. *Chrotogonus hemipterus*		E		A	A	NA	NA	NA	NA	ENA	ENA	A
3. *Phymateus viridipes*												A
4. *Zonocerus elegans*	NA	A	A								N	NA
5. *Pyrgomorpha dispar*	A	NA	N	A	NA	NA	N	N	NA	ENA	ENA	EA
Subfamily **Catantopinae.**												
6. *Leptacris monteiroi*								A	A			
7. *Acanthoxia gladiator*	EA		N	N	N			A	A	EA	EA	EA
8. *Afroxyrrhepes acuticercus*											EA	EA
9. *Afroxyrrhepes procera*	N	N	NA	A	E	E	A	A	A	A	A	A
10. *Anoxyrrhepes prosternalis*												
11. *Anoxyrrhepes* sp.											A	
12. *Homoxyrrhepes punctipennis*						A						
13. *Tristria dimorpha*								A				
14. *Tristria pallida*	EA								A	A	EA	EA
15. *Poeciloceratis striata striata*	EA									A	EA	EA
16. *Epistaurus* sp.	A					A	A	A	A	A	EA	A
17. *Bocagella bolivari*			N									
18. *Abisares viridipennis*											A	EA
19. *Catantops axillaris axillaris*	ENA	N	NA	NA	NA	NA	A	A	A	A	EA	EA
20. *Catantops decipiens*	A										A	EA
21. *Catantops melanostictus*	A	N	NA	NA	NA	A	A	A	A	A	EA	EA
22. *Catantops spissus adustus*	A				A						EA	EA
23. *Phaeocatantops decoratus decoratus*	A						A	A	A	A	EA	A
24. *Anthermus viridipes*									A	A	A	EA
25. *Rhytidacris tectifera*											A	
26. *Orthacanthacris humilicrus*	ENA		A				A	A			A	EA
27. *Nomadacris septemfasciata*	ENA	N	NA	NA	A	A	A	A	A	A	EA	EA
28. *Ornithacris cyanea cyanea*	A				A	A	A	A	A	A	EA	EA
29. *Acanthacris ruficornis lineata*			NA								EA	EA
30. *Cyrtacanthacris aeruginosa aeruginosa*	N	NA	ENA	EA	EA	EA						E
31. *Cyrtacanthacris tatarica tatarica*												A
32. *Eyprepocnemis plorans meridionalis*	ENA	N	ENA	ENA	ENA	ENA	NA	NA	NA	NA	NA	EA
33. *Cataloipus oberthuri*	EN	EN	NA	EA	EA	ENA	EA				E	E
34. *Tropidiopsis* sp.	N	N	NA	ENA	ENA	A	A					
35. *Tylotropidius gracilipes*						NA	EA	EA	EA	A	EA	A
36. *Tylotropidius speciosus*	ENA	EN	NA	N	NA	NA	A	A	EA	EA	A	A
Subfamily **Oedipodinae.**												
37. *Aiolopus femoralis*			A			A						A
38. *Aiolopus longicornis*	A	EA	A	A	A	A	A	A	A	A	A	
39. *Aiolopus* sp.	EA		NA	NA	ENA	ENA	NA	A	A	A	A	A
40. *Morphacris fasciata*	NA	A	NA	EA	ENA	ENA	NA	NA	NA	A	A	EA
41. *Trilophidia angustipennis*	EA	E	NA	N	NA	A	A	A	A	A	EA	EA
42. *Trilophidia conturbata*												A
43. *Acrotylus patruelis*	NA	ENA	NA	A	NA	NA	NA	NA	EA	A	EA	EA
44. *Acrotylus variegatus*	A		A				A	NA	A	A		
45. *Oedaleus nigeriensis*	EA	A	N	NA	ENA	ENA	NA				A	A
46. *Humbe tenuicornis*	ENA	ENA	ENA	NA	ENA	ENA	A	A	A		A	A
47 *Gastrimargus africanus*	ENA	ENA	NA	NA	NA	N	EN	NA	EA	A	A	A
48. *Locusta migratoria migratorioides*	A	A	NA	N	ENA	ENA	E	A			A	
49. *Paracinema tricolor tricolor*	A	EA	A							EN	NA	NA
Subfamily **Truxalinae.**												
50. *Gymnobothrus gracilis*	NA	NA	A	A		A	A	A	A	A	EA	A
51. *Gymnobothrus temporalis temporalis*	A					A	A	A	A	A	EA	EA
52. *Gymnobothrus* sp.								A	A	A		
53. *Rhabdoplea* sp.									A			
54. *Duronia tricolor*	A				A	EA	ENA			A	ENA	ENA
55. *Orthochtha alca*	N	N	NA	ENA	EA	A						
56. *Parga angusticornis*									A	A		
57. *Parga xanthoptera*								A	A	A	A	A
58. *Machaeridia* sp.								A	A	A	EA	EA
59. *Cannula linearis*									A	A	A	A
60. *Acrida bicolor*	EN	EN	NA	ENA	ENA	ENA	EA	ENA	A	N	E	EN
61. *Acrida turrita*		A	A			A						
62. *Acrida* sp.						A						
63. *Aulacobothrus wernerianus*	A						A	A	A	A	ENA	A
64. *Aulacobothrus* sp.								A				
65. *Faureia coerulescens*	A				A	A	A	A	A	A	EA	A
66. *Dnopherula crucigera*	A								A	A	EA	A
67. *Dnopherula marshalli*												A
68. *Pnorisa squalus*	A		NA				A	A	EA	EA	EA	A
69. *Afrohippus leai*	EN	NA	ENA	ENA	A	A					E	E
70. *Mesopsis laticornis*						A	A	A	A	A	EA	A
71. *Truxalis burtti*	A		A	NA	EA	A	A	E	E	ENA	A	A

TABLE 4.

The numbers and state of development of *Pyrgomorpha dispar* caught in the different habitats.

Month	JAN.	FEB.		MAR.	APRIL		MAY			JUNE			AUG.		SEPT.		OCT.		NOV.			DEC.
Habitat	5	5	6	5	5	6	1	5	6	4	5	6	5	6	5	6	5	6	4	5	6	6
Instar 1		2																				
Instar 2		3																				
Instar 3			1										1	1	11	2	2			1		
Instar 4				2											5	10	7		1	10		
Instar 5				4					1		1		1		3	3	1	1	1	12	2	
Instar 6								1					1		2	2				2		
Adult ♂	2				3	1		15		1	12	4					1	4	2	45	14	11
Adult ♀					2		1	12	3		7	1			1		1	2	5	37	5	8

TABLE 5.

Development of the ovaries of *Acanthoxia gladiator*.

Month	No. of ovaries examined	% showing development	% with eggs in oviducts
August	41	0	0
September	23	4	0
October	9	33	0
November	20	95	20

TABLE 6.

The numbers of *Acanthoxia gladiator* caught in the different habitats.

Month	SEPTEMBER					OCTOBER				NOVEMBER			JANUARY
Habitat	1	2	3	4	5	1	2	3	4	2	3	4	3
Adult ♂ ...	54	55	9	1		127	85	50	82			1	1
Adult ♀ ...	84	56	14		1	87	92	32	54	2	1		

Table 7.

The numbers and stage of development of *Catantops axillaris axillaris* caught in the different habitats.

Month	JANUARY					FEBRUARY					MARCH					APRIL						MAY					
Habitat	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	6	1	2	3	4	5	6
Instar 1	2	1			2	6	4			10																	
Instar 2	1	3		1	2	67	6	4		9	3	1			2												
Instar 3					1	47	8	25	3	16	11	6			6												
Instar 4						28	25	23	1	2	41	24	4	2	28	1				1							
Instar 5						5	9	6			60	76	11	5	30	6	2			5						1	
Instar 6											29	33	7	5	7	5	6	3	2	9	2	4				14	5
Adult ♂	103	60	6	7													11	1				2	3	1	2		
Adult ♀	43	29	1	2	1							2					6					2	10	1	1		1

Month	JUNE			JULY			AUGUST			SEPTEMBER				OCTOBER			NOVEMBER				
Habitat	1	2	3	2	3	4	1	2	3	1	2	3	4	1	2	3	1	2	3	4	5
Instar 1																					
Instar 2																					
Instar 3																					
Instar 4																					
Instar 5																					
Instar 6			1																		
Adult ♂	2	1		10	4		2		2	21	6	10	2	4	6	11	2	4	4	1	1
Adult ♀	9	1		14	3	4	9	2		38	15	4	1	2	1	2	2	2	4	8	

TABLE 8.

The numbers and stage of development of *Catantops melanostictus* caught in the different habitats.

Month	JANUARY						FEB.	MAR.	APRIL					MAY					JUNE		
Habitat	1	2	3	4	5	6	6	6	1	2	3	5	6	1	2	4	5	6	4	5	6
Instar 1							1														
Instar 3							2	2													
Instar 4								4													
Instar 5								6					4								
Instar 6								2	2	1	1	1					3	1			
Adult ♂	14	31	6	10	5	1			2					2	3	1	9	7	1	13	2
Adult ♀	19	81	17	1	3							3	2	2		2	15	8	1	12	3

Month	JULY				AUG.		SEPTEMBER				OCTOBER				NOVEMBER					
Habitat	3	4	5	6	5	6	1	3	5	6	1	4	5	6	1	2	3	4	5	6
Instar 1																				
Instar 3																				
Instar 4																				
Instar 5																				
Instar 6																				
Adult ♂		1			3	1	1	1	37	28	2		8	57	46	39	11	96	51	46
Adult ♀	1		1	3	2	1		2	26	10	1	2	4	30	41	40	12	101	33	29

TABLE 9.

The numbers and stage of development of *Nomadacris septemfasciata* caught in the different habitats.

Month	JANUARY				FEBRUARY					MARCH					APRIL	MAY			JUNE		JULY	
Habitat	1	2	3	5	1	2	3	4	5	1	2	3	4	5	2	1	2	4	2	3	2	3
Instar 1	21	98	74	2	7	4			3													
Instar 2	8	77	20	3	13	32	5	1	22	1												
Instar 3			14	1	28	225	57	2	17	2	2											
Instar 4					19	253	70		3	19	22	7	6	1								
Instar 5						35				5	107	2	1									
Instar 6						1				1	114	3		2	3							
Adult ♂		9	4								21	1			9	3	105	1	33		55	1
Adult ♀	2	3		1							8				10	5	92		18	1	17	1

TABLE 10.

The percentages of different coloured hoppers of *Nomodacris* caught in different habitats.

	% green hoppers	% brown hoppers	Total No. examined
Sporobolus	73	27	98
Echinochloa...	5	95	757
Diplachne	7	93	153
Hyparrhenia	60	40	10
Woodland	92	6	49

TABLE 11.

Development of the ovaries of *Nomadacris septemfasciata* in 1955-1956.

Month	No. of ovaries examined	% showing development
October	894	0
November	2580	4
December	1790	85
January	126	85

TABLE 12.

The percentages of undeveloped ovarioles found in three ovaries of *Nomadacris septemfasciata* examined on 12.1.56.

Length of ovary	Lengths of E_1	Length of accessory gland	No. of large ovarioles	No. of undeveloped ovarioles	% of undeveloped ovarioles
24 mm.	4-5 mm.	5.5 mm.	77 + 73	12 + 13	16.6
25.5 mm.	4-5 mm.	5.0 mm.	69 + 68	6 + 11	12.4
15.5 mm.	3-4 mm.	4.7 mm.	79 + 77	4 + 4	5.2

TABLE 13.

The numbers and stage of development of *Cyrtacanthacris aeruginosa aeruginosa* caught in the different habitats.

Month	JANUARY					FEBRUARY				MARCH					APRIL			MAY				JUNE			
Habitat	1	2	4	5	6	1	2	5	6	1	2	3	5	6	1	2	6	1	2	4	5	1	2	5	6
Instar 1								3																	
Instar 2	2	1						1																	
Instar 3	4	2	1			1		1					1												
Instar 4	1	1		6	1	2							2												
Instar 5				1		6	1							1											
Instar 6							3	1	1																
Adult ♂							1			5	2	1			1	3	1	13	8	2	1	4	3	2	2
Adult ♀										3		1			2	4		2	1		1		1		

TABLE 14.

The numbers and stage of development of *Eyprepocnemis plorans* caught in the different habitats.

Month	JANUARY				FEBRUARY		MARCH					APRIL			MAY				JUNE				
Habitat	1	2	3	4	1	2	1	2	3	4	5	1	2	3	1	2	3	4	1	2	3	4	6
Instar 1	2												2										
Instar 2					9	12	4	2															
Instar 3	2			3	47	92	14	22	3			1			1				4			1	
Instar 4	1				6	30	13	42	16	1	1		1						3				1
Instar 5								29	11		1	3	2	1	1	2							
Instar 6								5				5	8	1	1	2	1			1	1		
Adult ♂	15	12	8				1					3	1	1	2	4		1	3	4	2		
Adult ♀	2	4	3				1	2				1	5		7	10			9	3	1		

Month	JULY			AUGUST				SEPTEMBER					OCTOBER				NOVEMBER				
Habitat	2	3	4	1	2	3	4	1	2	3	4	5	1	2	3	4	1	2	3	4	5
Instar 1																	1				
Instar 2																					
Instar 3				1	3		5						1								
Instar 4				2	7		4				2		1								
Instar 5			1		2		3				7		2								
Instar 6			1	1	5		6			1	21										
Adult ♂	2	10	44	5	7	33	16	18	32	43	101		81	6	34	24	11	58	27	39	1
Adult ♀	11	18	16	1	16	18	11	53	27	32	49	1	37	4	17	14	6	28	15	12	1

TABLE 15.

Development of the ovaries of *Eyprepocnemis plorans meridionalis*.

Month	No. of ovaries examined	% showing development
March	1	100
April	1	100
May	7	58
July	14	0
August	16	0
September	1	0
October	19	5.5
December	12	100

TABLE 16.

The numbers and stage of development of *Cataloipus oberthuri* caught in the different habitats.

Month	JANUARY					FEBRUARY					MARCH				APRIL				MAY					JUNE					JULY
Habitat	1	2	3	4	5	1	2	3	4	5	1	2	3	4	1	2	3	4	1	2	3	4	5	1	2	3	4	5	2
Instar 1		1	1																										
Instar 2		19						16	1																				
Instar 3		11		3	1	1	1	43	2		2																		
Instar 4	3	1	9		4	11	26	23	1	1	3	4		1															
Instar 5						5	41	7	2	3	5	1																	
Instar 6							9	1			3	10	1	4															
Adult ♂											2	23	3	2	8	17	12	5	68	28	4	20	11		23	16	3	2	2
Adult ♀											1	18	1		25	41	6	2	66	46	8	21		1	8	8			

TABLE 17.

The numbers and stage of development of *Tropidiopsis* caught in the different habitats.

Month	JANUARY			FEBRUARY			MARCH					APRIL		MAY		JUNE		JULY
Habitat	4	5	6	1	5	6	1	2	3	5	6	5	6	5	6	5	6	6
Instar 1	4																	
Instar 2	2		1															
Instar 3	6	4	12	10	4				4	2								
Instar 4	2	1	3	2	1		2	1	1	9								
Instar 5	1				5	8				6								
Instar 6					1								1					
Adult ♂										5	3	1		3	5	3	2	1
Adult ♀										3	6		4	2	8		15	

TABLE 18.

Development of the ovaries of *Tylotropidius speciosus*.

Month	No. of ovaries examined	% showing development	% with eggs in oviducts
August	3	100	0
September	2	100	0
October	32	75	9.5
November	19	100	10.5
December	34	100	18

Table 19.

The numbers and stage of development of *Morphacris fasciata* caught in the different habitats.

Month	JANUARY			MARCH		APRIL		MAY			JUNE					JULY			AUGUST		SEPT.		OCTOBER		NOVEMBER			DEC.
Habitat	3	5	6	5	6	5	6	4	5	6	1	3	4	5	6	2	5	6	5	6	5	6	5	6	4	5	6	6
Instar 3															6		1	3		1								
Instar 4			1							6					28		2	6	2	5		4						
Instar 5			2		2				1	2				2	33		10	7		10		19						
Adult ♂		6	58	4		1	1	1	9	2	1	1		18	41	1	21	31	1	10		36	4	28		2	6	3
Adult ♀	1	7	47	2	2	3	1		13	2		1	1	21	40		17	40	1	6	1	49	3	24	1	2	23	6

Table 20.

Development of the ovaries of *Morphacris fasciata.*

Month	No. of ovaries examined	% showing development
March	4	100
July	1	100
August	24	9
September	16	0
October	5	0
November	19	100

TABLE 21.

The numbers and stage of development of *Acrotylus patruelis* taken in the different habitats.

Month	JANUARY						MARCH			APRIL	MAY		JUNE				JULY			AUGUST			SEPT.		OCTOBER		NOVEMBER		
Habitat	1	2	3	4	5	6	2	5	6	6	5	6	1	4	5	6	3	5	6	1	2	5	5	6	4	5	1	4	5
Instar 3														1		1													
Instar 4				1	1							1	1		1	2													
Instar 5							1	1				1	1		2	5		2	6			2							
Adult ♂	1			7	16			8	1		5		1		3	8	1	2	6		1	7		1		1	1	2	3
Adult ♀	6	1	1	10	13	6		5	2	1	1		4	2	2	2		3	5	1	1	10	1		1	5	2	4	6

TABLE 22.

The numbers and stage of development of *Oedaleus nigeriensis* taken in the different habitats.

Month	JAN.		FEB.	MAR.	APRIL				MAY				JUNE				JULY	
Habitat	5	6	6	6	1	2	4	6	1	2	5	6	1	4	5	6	5	6
Instar 2					2													
Instar 3				2	8	1				3								1
Instar 4				14	33	10	2	6	2	2	2			2				
Instar 5				13	17	6		12	5	1	2		1	3				
Adult ♂	19	8						2			7	57	4	1	3	48	3	6
Adult ♀	5	3	2		1						6	49	5			62	1	2

TABLE 23.

The numbers and stage of development of *Humbe tenuicornis* caught in the different habitats.

Month	JANUARY			FEBRUARY			MARCH		APRIL		MAY			JUNE	JULY		AUG.	SEPT.	DEC.
Habitat	3	5	6	3	5	6	5	6	1	6	1	5	6	6	5	6	6	6	6
Instar 2						2													
Instar 3	10	1		1	5	7			1				2						
Instar 4							3			1			11	3					
Instar 5							8			3			11	4					
Adult ♂		1	2				1			10		3	35	14	1	1	6	3	
Adult ♀			2					2		11	1	5	30	17	1		2		6

TABLE 24.

The numbers and stage of development of *Orthochtha alca* caught in the different habitats.

Month	JANUARY			FEBRUARY				MARCH					APRIL				MAY				JUNE
Habitat	1	4	5	1	2	4	5	1	2	3	4	5	1	2	3	4	1	2	3	4	3
Instar 1			1																		
Instar 2	11	1	2																		
Instar 3	11	5	1	60	2	8		1													
Instar 4				28	15	12															
Instar 5				45	7	7	9	21													
Instar 6				28	2			75	4	3	14		1								
Adult ♂								72	19	11	14	1	18	24	15	2	16	6	3		
Adult ♀								37	13	9	7		47	26	10	1	32	24	5	3	2

TABLE 25.

The numbers and stage of development of specimens of the genus *Acrida* caught in the different habitats.

Month	JANUARY					FEBRUARY					MARCH					APRIL					
Habitat	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	6
Instar 2		6	15		1					1		3				1					
Instar 3	2	41	689	4	5	20	37	80	1		3	11	5	1	1	1	2				
Instar 4	9	1	110		9	40	106	284	3		10	39	95			2	3	3			
Instar 5			5	1		19	64	120	1	2	20	121	96	5		4	3	27			
Instar 6						3	6	14		1	29	162	123	4	3	6	24	79			
Adult ♂											6	58	47	4	9	283	51	118	7	10	2
Adult ♀											1	3	3		1	181	37	32	2	6	2

Month	MAY						JUNE						JULY				AUG.		OCT.
Habitat	1	2	3	4	5	6	1	2	3	4	5	6	2	3	4	5	2	3	3
Instar 2																			
Instar 3																			
Instar 4		1						1	1										
Instar 5			4					1	1										1
Instar 6	1	8	8																
Adult ♂	60	62	166	6	22	2	57	32	46	5	8	3	3	4	5	1	1		
Adult ♀	78	62	55	6			10	4	59	2	6	2	1	6				1	

TABLE 26.

The numbers and stage of development of *Afrohippus leai* caught in the different habitats.

Month	JANUARY					FEBRUARY					MARCH					
Habitat	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	6
Instar 1	4	11	1			23		7								
Instar 2	114	100	1	1	16	227		28								
Instar 3	120	114	3	1	109	68	2	9			6		6	2		1
Instar 4	89	85	1	1	111	241	53	1	8	1	4		13			
Instar 5					12	359	382	12	19	1	18	9	20	1		
Adult ♂						46	131	10	6	2	781	396	68	94	52	
Adult ♀							4				685	599	72	131	41	

Month	APRIL					MAY					JUNE			
Habitat	1	2	3	4	5	1	2	3	4	5	1	2	3	4
Instar 1														
Instar 2														
Instar 3														
Instar 4		1												
Instar 5	1	1	2											
Adult ♂	562	249	69	5	2	213	154	29	4	13	2	36	19	1
Adult ♀	630	319	41	3		381	273	39	5	2	2	97	53	1

TABLE 27.

Species surviving the dry season in the egg.

Pyrgomorpha.	*Tropidiopsis.*
Afroxyrrhepes procera.	*Orthochtha.*
Cyrtacanthacris.	*Acrida bicolor.*
Cataloipus.	*Afrohippus.*

TABLE 28.

Species surviving the dry season as adults.

Acanthoxia.	*Nomadacris.*
Afroxyrrhepes acuticercus.	*Ornithacris.*
Anoxyrrhepes.	*Aiolopus longicornis.*
Tristria pallida.	*Aiolopus* sp.
Poecilocerastis.	*Trilophidia angustipennis.*
Epistaurus.	*Gymnobothrus gracilis.*
Catantops axillaris.	*G. temporalis.*
C. melanostictus.	*Machaeridia.*
C. spissus.	*Aulacobothrus wernerianus.*
Phaeocatantops.	*Faureia.*
Anthermus.	*Mesopsis.*
Orthacanthacris.	

TABLE 29.

The numbers of species in the different subfamilies with one, two or three generation per year.

Subfamily	Number of generations		
	1	2	3
Pyrgomorphinae	1	0	2
Catantopinae	13	1	0
Oedipodinae	3	6	0
Truxalinae	9	2	0

TABLE 30.

Numbers of ovarioles in the different species compared with data from Waloff (1954) and numbers of eggs in egg pods (Chapman and Robertson, 1958).

Species	Present data			Waloff 1954	C. & R. 1958
	Av. ♀ body length in mm.	No. ovarioles	ovarioles per mm.	No. ovarioles	No. eggs
Chrotogonus	19.6	19- 36 (6)	1.70	32-36 (2)	20- 34 (10)
Zonocerus	43.7	143 (1)	3.30		
Pyrgomorpha	31.3	91-143 (21)	3.70		44-115 (10)
Acanthoxia	82.2	58- 70 (15)	0.77	66-76 (3)	20- 50 (10)
Afroxyrrhepes acuticercus .	No data	77 (1)			57- 82 (4)
A. procera	61.4	85-100 (9)	1.50		34- 91 (10)
Anoxyrrhepes	46.8	56 (1)	1.19	44-50 (2)	
Catantops melanostictus ...	28.2	46- 60 (12)	1.86	48 (1)	26- 74 (10)
C. spissus	44.2	57 (1)	1.28	48 (1)	48- 57 (2)
Phaeocatantops	27.4	38- 47 (10)	1.57		27- 47 (10)
Nomadacris	No data	154-175 (3)		179 (1)	77-189 (15)
Ornithacris	74.8	129-188 (3)	2.20		158-164 (3)
Eyprepocnemis	37.4	64-100 (17)	2.07	76-84 (3)	30- 80 (11)
Cataloipus	54.3	131-181 (10)	2.72		22-103 (11)
Tropidiopsis	35.8	40- 45 (3)	1.19		24- 38 (6)
Tylotropidius gracilipes ...	36.9	37- 56 (14)	1.32		24- 44 (10)
T. speciosus	44.2	52- 89 (62)	1.44	66 (1)	29- 54 (10)
Aiolopus longicornis	26.4	24- 43 (9)	1.17		31 (1)
Aiolopus sp.	22.8	18- 41 (6)	1.29		7- 25 (11)
Morphacris	28.2	19- 44 (11)	1.30		14- 34 (10)
Trilophidia angustipennis ...	19.3	26 (1)	1.35		13- 25 (10)
Acrotylus patruelis	21.9	24 (3)	1.09		9- 25 (11)
Oedaleus	30.6	37 (1)	1.21		12- 42 (10)
Gastrimargus	40.9	76- 83 (4)	1.94		39- 61 (10)
Locusta	54.7	96-109 (2)	1.87		52- 91 (10)
Paracinema	38.7	109-153 (4)	3.59		66-127 (10)
Gymnobothrus gracilis	18.2	13- 19 (5)	0.92		8- 14 (10)
G. temporalis	18.0	19- 24 (7)	1.17		8- 14 (10)
Gymnobothrus sp.	16.9	17 (1)	1.00		
Duronia	32.3	51- 59 (9)	1.67		13- 53 (18)
Orthochtha	36.4	26- 34 (23)	0.81		16- 47 (4)
Parga xanthoptera	25.9	16 (1)	0.62		
Acrida bicolor	66.9	88-106 (11)	1.46		31- 88 (42)
Acrida sp.	72.7	97-103 (2)	1.38		
Aulacobothrus wernerianus.	20.7	22- 27 (4)	1.13	16 (2)	4- 25 (10)
Faureia	24.5	17- 20 (10)	0.74		5- 18 (10)
Dnopherula crucigera	21.4	25- 29 (3)	1.26		10- 28 (9)
Pnorisa	24.7	34- 38 (5)	1.44	30-44 (5)	8- 30 (10)
Afrohippus	25.3	24- 30 (22)	1.05		10- 22 (12)
Mesopsis	59.3	46 (1)	0.78	40 (2)	13- 48 (2)

Figures in brackets show the number of specimens examined.

TABLE 31.

The number of ovarioles in the two ovaries per mm. of body length found in members of the different subfamilies.

Subfamily	Number of species with this number per mm.					
	0.50-0.99	1.00-1.49	1.50-1.99	2.00-2.49	2.50-2.99	3.00 and over
Pyrgomorphinae			1			2
Catantopinae	1	5	3	2	1	
Oedipodinae		7	2			1
Truxalinae	5	8	1			

TABLE 32.

The number of species in the different subfamilies found in the grassland and woodland habitats.

Subfamily	Habitat		
	Confined to grassland	Confined to woodland	Present in both
Pyrgomorphinae	0	4	0
Catantopinae	10	12	9
Oedipodinae	4	2	7
Truxalinae	5	8	9
TOTAL	19	26	25